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AGRICULTURE AND LIVE-STOCK IN INDIA

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Page 127, line 31 *for* ' products in 1933-34 was 32·3 crores ' *read* ' products in 1933-34 was 13·2 crores '.

Page 127, line 32 *for* ' figure was only 12·9 crores ' *read* ' figure was only 12·1 crores'.

Page 401, Table I (*a*) *Ratio—straw/grain* Column 5, against ' Treatments ' *for* ' $0 \cdot \bar{1} \cdot 0785$ ' *read* ' 0·0785 ' and against ' Error ' *for* ' 1·3957 ' *read* ' $\bar{1} \cdot 3957$ '.

Page 402, Table I (*b*) *Stand*, Heading of column 5, *for* $\frac{1}{2} \log \left[\frac{M.S.}{100}\right]$ *read* $\frac{1}{2} \log_e \left[\frac{M.S.}{100}\right]$

Page 403, Table I (*c*) *Analysis of variance* (*Unit* —$\frac{1}{2}$ *oz.*), Heading of column 5 *for* $\frac{1}{2} \log$ (M.S.) *read* $\frac{1}{2} \log_e$ (M.S.)

Page 403, Table I (*c*) *First picking*, Heading of column 5 *for* $\frac{1}{2} \log \left[\frac{M.S.}{100}\right]$ *read* $\frac{1}{2} \log_e \left[\frac{M.S.}{100}\right]$

Page 406, 3rd line from the bottom *for* 9 *read* 19.

Page 549, line 8 *for* " Cake " *read* " No cake ".

Page 553, line 11 *for* " Bose, S. (1933). Unpublished work " *read* " Bose, P. K. (1933). *Modern Review*, Vol. LIV, No. 2, 1933 ".

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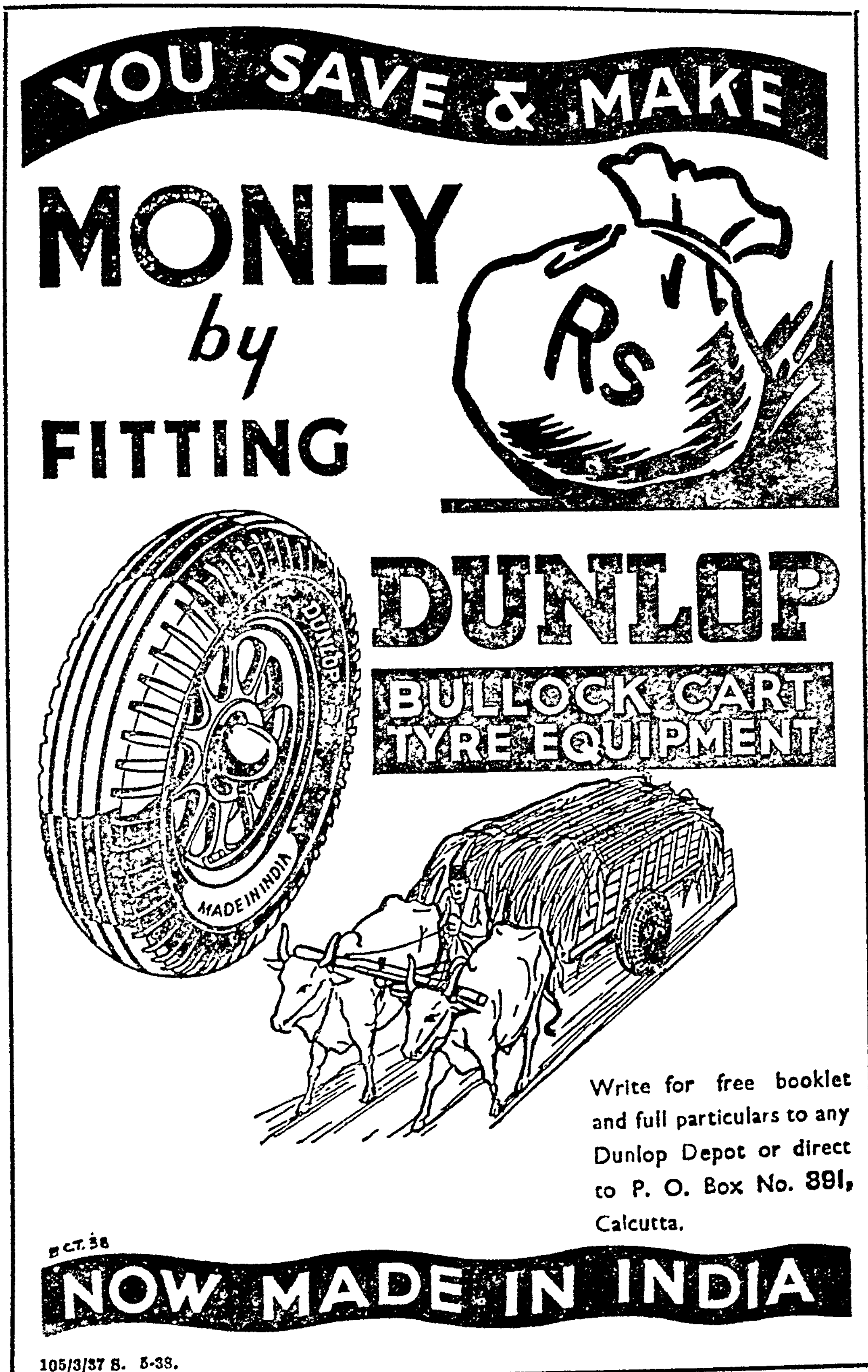
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May, 1938

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Vol. VIII, Part III, May 1938

EDITORIAL

THE ALL-INDIA CATTLE SHOW, FEBRUARY 1938

The 1937-38 season will be a notable one from the fact that for the first time an All-India Cattle Show was organized, at the Irwin Amphitheatre, New Delhi, alongside the Annual Show of the National Horse Breeding and Show Society. Though the time available for organising such a show was very short, cattle from most of the important breeding areas were on view and created a great deal of interest not only among cattle breeders but also among the general public, many of whom had previously no idea that such beautiful animals as they saw paraded in the arena could be produced anywhere in India.

Some important breeds were unfortunately not represented, but particular mention must be made of the outstanding display of Hariana, Hissar, Hansi, Sahiwal and Dhanni cattle and Murrah and Nili buffaloes which was organized and sent up to the show by the Veterinary Department of the Punjab and of the following representative exhibits which were sent up by Indian States, *viz.*, Red Sindhi, Malvi and Nimari cattle and Murrah and Jaffarabadi buffaloes from Dhar State, Bhagnaris from Kalat, Girs from Junagadh, Rath and Mehwatis from Alwar, Deonis from the Nizam's Dominions, Nagoris from Jodhpur, Amritmahals and Hallikars from Mysore, Mehwatis from Bharatpur and Kankrej from Radhanpur State.

Inevitably, in such a huge country, considerable expenditure is involved in bringing such a representative gathering of cattle together, and a good deal of suasion was needed in some cases to induce owners to permit their animals to come. Village owners, always suspicious of innovations and the intentions underlying such a proposal, were not at first willing and all sorts of misfortunes were predicted: disease would be rampant, distracted bulls

would be a serious danger to the public and the appearance of the Viceroy's Bodyguard in scarlet would so infuriate them that the Viceroy himself would be in grave danger of his life None of these dreadful things happened however no case of contagious disease or serious illness occurred and the provision which was made for isolation and treatment of cases was little used except to isolate all animals on arrival, the bulls behaved as perfect gentlemen should and the Viceroy was able to arrive and depart in appropriate state and to closely inspect outstanding representatives of the different breeds without the slightest danger His arrival in state and visits to the cattle show ground in fact gave photographers wonderful opportunities of securing most interesting and informative photographs which must be of great value to all who are interested in Indian rural life and beautiful cattle Standard photographs against a black background marked in 6 in squares, were also taken and will be issued as a supplement to the special bulletin which was prepared by the Animal Husbandry Expert of the Imperial Council of Agricultural Research for this show, giving a brief survey of the different breeds Moving pictures of the pageantry of the Viceroy's arrival and of the parades and show yard were also taken and will shortly be exhibited, which give a wonderful impression of this unique show, in its beautiful setting among some of the most impressive examples of Indian architecture of past centuries It seems certain that such a striking picture cannot fail to appeal to a very wide public, all over the world and to give Indian cattle the widest possible advertisement, and that the grant of funds from the Government of India which made the show possible was amply justified

But to provide for the needs of such a variety of cattle and their attendants from all over India a great deal of arrangement and forethought was necessary In addition to the provision of the usual judging rings with accommodation for the public and trade exhibits, suitable food and accommodation for over 400 animals and their attendants of different creeds and communities, had to be supplied, from ten days to a fortnight, and not the least difficult matter which the Secretary had to attend to was to provide food for animals which were not accustomed to the fodder commonly fed to cattle in northern India Provision for isolation and for veterinary care of sick had also to be made, and camp for the officers in charge and kitchen and feeding accommodation was provided as well as suitable food and proper sanitation for the men as well as their animals Such difficulties as arose were however overcome and all concerned with the organisation of the show are to be congratulated on the way in which between four and five hundred animals were assembled and dispersed without mishap

Moreover, it is encouraging that in the course of the show a number of animals were sold, at prices far higher than they would otherwise have realized, and it is hoped that, with wider support, it may be possible to establish the All India Cattle Show as an annual event of great importance to breeders of pedigree stock all over India

A Jat of the United Provinces—A Soldier Cultivator

ORIGINAL ARTICLES

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

1. THE JAT CULTIVATOR

BY

ABDUL HAMID KHAN SAHABZADA

Divisional Superintendent of Agriculture, Western Circle, Meerut

THE *Jat cultivators of the United Provinces are mainly concentrated in the* western districts but have now spread more or less throughout the Province wherever conditions promise a livelihood from cultivation and cattle. With traditions deeply rooted in agriculture they are a sturdy and independent race, loyal alike to their land and to its service in arms. (Wherever a Jat community is found, there one can look with certainty for a high standard of cultivation, a long-standing tradition of hospitality, an independent outlook, directness of speech, and loyalty to one's salt)

Let us look at a typical though perhaps prosperous above-average representative in the State tube-well area in Meerut district. As we are proceeding on our way, we remark excellent crops of sugarcane in solid blocks, with the tube-well building at the highest point in the area. Reaching our village, we observe that the Jat houses of brick, or with neat and well-built mud walls, are far superior in quality and maintenance to those of the general run of cultivators of the Province and that the people are better dressed and appear both healthier and happier. Entering the village we are greeted and invited to sit and to rest a while on a strong well-built charpoy. (A peep into our host's courtyard shows the cattle and young stock being given their morning feed. The cows are of the Hissar type, giving a fair quantity of milk and there seems to be an abundance of green fodder. The care given to the cattle is obvious.)

The head of our host's household is the old grandfather, hale and hearty, and a personality in the councils of the village panchayet. Retired from a famous Jat Regiment, he is full of stories of his adventures in the Great War in France and Mesopotamia. The care of zemindari and cultivation he has handed over to his elder son, our host himself contributing traditional council and shrewd though somewhat conservative comment. The younger son is with "the Regiment" where his recent promotion has brought joy to the heart of the old warrior.

There are four grandchildren two boys, of whom the eldest has already followed the family tradition of military service and two girls shortly to be married. The father has already made arrangements for borrowing from the Banya for the girls' marriages "Every one must spend to put up a good show when one marries one's daughter" His savings were not enough, as he wanted to invest in improved agricultural implements which were so much the talk of the village The Deputy Saheb had given their village a set of improved implements as aid to the *Gram-sudhar* (village uplift) Our host had tried these and found that they were effective "if one followed the rules of good husbandry", and he must have his own set

The youngest son attends the village school On the subject of schooling the grandfather is somewhat scathing telling his son that it is no use sending the boy to school It will only result in his running away to town and becoming a clerk! "We are not that class either we must till the soil or we must be soldiers"

The Jats as a race are fine ploughmen with traditional knowledge of the art of tilling the soil at the proper time and of preparing a fine seed bed That our host is no exception is obvious from his land and the condition of his crops These are his first interest and his main delight but when the work of the day is over he is happy to sit in the evening in his small *chaupal* (raised sitting out platform) and to discuss the events of the day and village interests to the accompaniment of his *huqqa* The *Chamars* of the village are at the moment somewhat of a problem The introduction of tube well irrigation the block sowing of crops with re align ment and straightening of field boundaries the introduction of labour saving devices have reduced the demands upon daily labour thus creating a minor unemployment problem Our host had suggested to help them provided they settle down to cultivation of the land but they prefer the freer if more precarious existence by daily labour and selling grass and fuel in the town

That our host and his fellow Jats are alive to the possibilities of agricultural improvement is evident when we walk through the fields He himself has 300 bighas (about 50 acres) of zemindari, of which he cultivates 200 Of this he has already remodelled 80 bighas along with his fellows under the advice of the Agricultural Development Officers The fields have been reshaped with straight *mends* (field boundaries) and direct water channels and the crops are sown in solid blocks with roadways running through them made by the owners of the fields themselves Once the advantage had been realised by the village there was no objection to re adjustment of field boundaries and a division of the irrigated area into blocks which followed the approved rotation Thus without the difficulties of consolidation of holdings they had reaped most of its advantages As he proudly explained ' we are following the old system of *Har Kheti*, i e, division of the area into solid blocks for *Kharif*, *Rabi* and *Dofasli* with a little grazing and

a small grove of mangoes ", and they were quite happy with the result of their co-operative effort. Yields were increasing, irrigation had become easy and watching the crops a game. Irrigation from the tube-well had sent their cane shooting to the heavens.

He was rightly proud of his cane crop which we estimated at 800 maunds to the acre. This was nearly all destined for the sugar factory. Only one *Kolhu* (bullock power crusher) remained in the village for *gur* for local consumption. "This year," he said " we are taking all to the factory. We get only Rs. 2-4 for a maund of *gur* which hardly pays its way and *gur* is difficult to keep. Sold to the factory we have no further worry with it. We have contracted for the whole lot through the Co-operative Inspector who has set up a centre in the village ".

Thus a Jat is not shy of using agencies which are to his advantage or of adopting unfamiliar methods when their value has been demonstrated. The cane had been sown in lines suitably earthed up and where necessary tied in stools to prevent lodging. Green manuring with *sanai* is becoming a general practice in the village and in our host's opinion was " a great friend, particularly of the small cultivators, whose stock of dung manure is insufficient."

A Jat finds plenty to keep him busy throughout the year in the fields with his crops and his live-stock. The high spots of his life are occasional. A chorus at *Holi*, merry-making at *Dusehra*, an occasional visit to market, and domestic ceremonial occasions appear to afford all the variety he desires outside the care of his house, his cultivation and the affairs of the village. Let there, however, be word of a wrestling match, and whether he is of a suitable age, or too young, or too old to participate, he will be there unless his major interests prevent him.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

2. THE MUSLIM CULTIVATOR OF OUDH

BY

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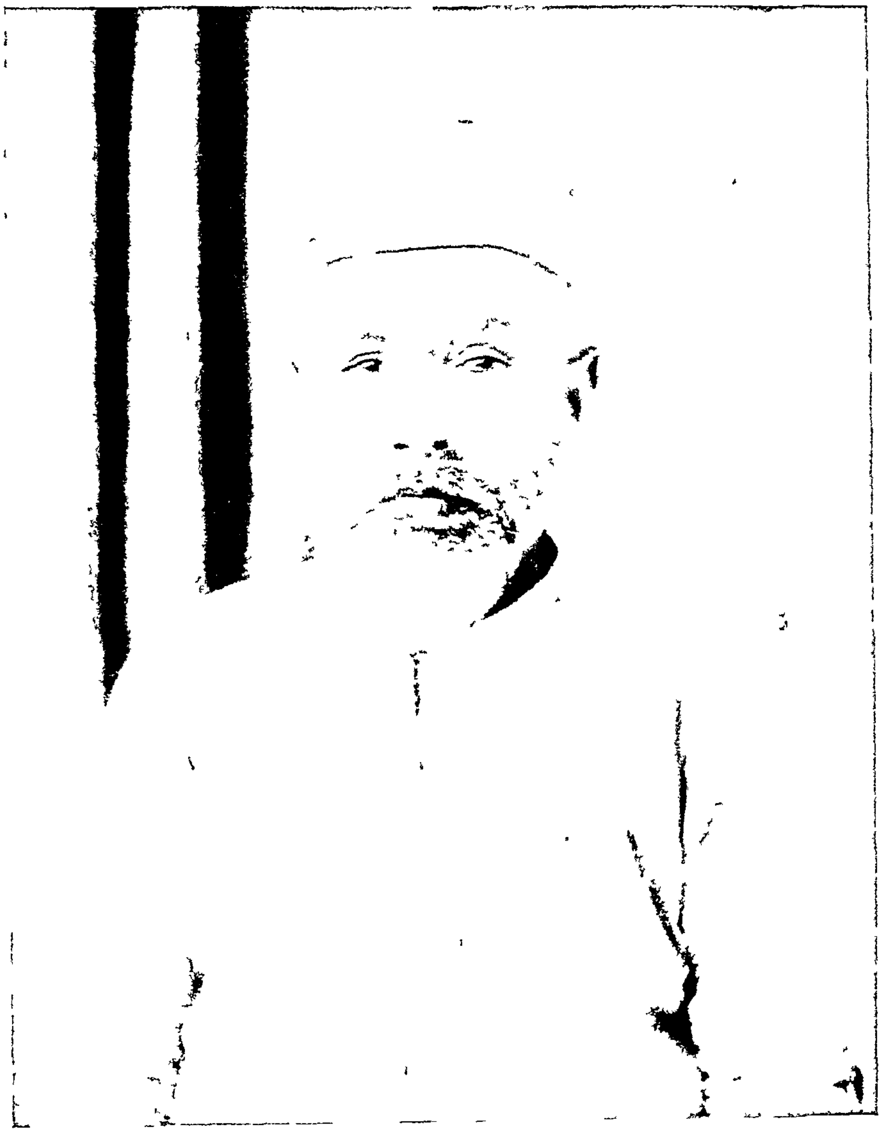
ALTHOUGH practically 99 per cent of Muslim cultivators in Oudh belong to the Sunni sect, any Muslim, whether he is Shia or Sunni, (Sheikh, Moghal or Pathan) may, without prejudice, adopt the profession of a cultivator. Most Sheikh and Pathan Muslims in the villages are engaged in side industries such as oil crushing, spinning, pottery and the rearing of goats and cattle chiefly for milk. This is done, however, in addition to their ordinary work as cultivators. Of the Sheikhs and Pathans, both of whom are Sunnis, the Pathan represents the majority of the Sunni cultivators. He is a staunch Muslim and is recognised generally by a beard typical of his class, with moustaches trimmed short or shaved in the middle. He follows strictly the teachings of Islam, especially in the matter of regular prayers and fasting during the month of *Ramzan*. In places where he is in a small minority and very much influenced by the Hindu majority, he will enjoy such Hindu festivals as *Diwali* and *Holi*. This applies, however, to the illiterate cultivator only.

The Muslim cultivator gets his children taught to read the Holy Quran but not necessarily to read Urdu. The children are taught to respect their religious observances. The Pathan cultivator of Oudh is generally well built and of robust health. He is both industrious and skilful. He leads a simple life wearing a cloth like a *dhoti* known as the *tahband*, and a shirt or *kurta*. These are made of village spun cloth. During winter he wears, in addition, a rustic form of a tight-fitting garment known as a *shaluka* in which, between the lining and the cover, is stuffed a liberal amount of cotton. His bedding at night consists of a mattress of paddy straw, either on the ground or on a cot, and a covering of rough cloth. His food consists chiefly of pulses, vegetables, rice and unleavened bread made of either wheat, barley, maize or *bajra*. When he eats meat, it is generally beef. He both chews and smokes tobacco.



A Muslim (Pathan) Cultivator of Oudh

The young Muslim cultivator marries between the age of fifteen and twenty. The parents do their best to provide money for feasts, dances and the presentation of silver ornaments to the bride.

His womenfolk help the Muslim cultivator in his daily work in the fields. They both take pride in raising good crops. The standard of cultivation is generally good and plenty of manure is given which is obtained from the cattle he keeps. He is also industrious in providing irrigation from wells for his crops. Being a shrewd and intelligent man, the Muslim cultivator of Oudh looks upon his profession from a business like point of view and is generally a successful cultivator.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

3 THE KURMI CULTIVATOR

BY

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THE Kurmi or Kumbi is a good, hard-working cultivator Agriculture is his main and hereditary occupation His ways of life are simple. His women folk do not observe *pardah* and are free to work outdoors without any social let or harm Widow remarriage is common among them It is true that in the olden days they were not recognised in the higher social groups of the Hindu caste system, but they were never classed as untouchables From ancient times they have been occupying the advantageous position of the producers of food which had a ready market

With the establishment of a stable form of Government, the various legislative measures gave security of tenure and removed other disabilities in the way of ordinary farmers Then the Kurmi made rapid strides in economic matters and to day we find some very big landlords amongst Kurmis The key of economic prosperity and solvency of an average Kurmi family of farmers is his industry, simplicity and docility The head of a Kurmi family will arise generally one hour before sunrise He will have a few whiffs at his *hookah* and will finish his morning ablutions He will go to his fields and start work at sunrise with other members of his family, leaving a few women at home to take care of the children and cook food for all After working for about three hours he stops work for about thirty minutes for breakfast Breakfast mostly consists of parched grain and sometimes *gur* After breakfast work is resumed and is continued till about twelve noon when he returns home He takes his bath in a river, tank or well according to the facilities available and then enjoys his midday meal After finishing this meal he rests for a while, and then sets off for the afternoon work in the fields till sunset

On his return from a day's work in the field he is busy at home with some indoor occupations such as the care of cattle and live stock, extraction of fibre from *sann* hemp, making ropes and string, *tat* weaving and so on for a few hours till the night food is ready This night meal is taken at about 9 P M and then he retires for the night

A Kurmi Cultivator of the United Provinces

The agriculture of Kurmis, despite its antiquity, is still primitive and largely empirical. Modern scientific developments, which have revolutionized the agriculture of other civilized countries, have had but little effect on the agricultural practices of Kurmis. They handle the wooden ploughs to-day which were used by their forefathers from time immemorial. Their general illiteracy, deep-rooted superstitions, and small and scattered holdings are some of the great impediments in the way of their agricultural progress. No wonder, then, that the agriculture practised under such conditions should remain unaffected by modern improvements. It is rather creditable to the Kurmi cultivator that, working against heavy odds, he manages to produce excellent crops on his fields and very successfully competes with his more advantageously placed fellow cultivators. He possesses a very clear knowledge of agriculture as a result of tradition handed down from generation to generation and is perfect in the art of crop raising. Every Kurmi cultivator commits to memory a large number of agricultural sayings on different agricultural subjects, such as preparation of seed-bed, time of sowing, manuring, weather forecasts, live-stock and so on. " Ghagh " the originator of most of these agricultural sayings is said to have been a very intelligent Kurmi agriculturist in the hoary past.

A Kurmi farmer is generally guided in his agricultural practice by experience, both hereditary and acquired, and by these agricultural sayings. He uses simple and cheap agricultural implements and keeps one pair of bullocks for every five acres of land. He also keeps two to four milch animals on his farm. He likes and plants some fruit trees on his holding. Such fruits are generally mangoes, *Kathal, Mahua, Jamun, Ber*. He grows also a few clumps of bamboos which he requires for the repair of his houses and other agricultural work. He will prefer to have a masonry well on his holding for the irrigation of his crops, but, unfortunately, in the majority of cases the conditions do not permit of this.

To augment his agricultural income the Kurmi farmer generally takes to some other work such as (1) Making ropes and strings for sale, (2) Weaving *tats* (rough cloth) for sale, (3) Plying carts for hire, (4) Service on another village farm or in towns as *chaukidar, chaprasi* or *munshi*.

The house of an average Kurmi is generally built of mud walls and tiled roofs. It consists generally of a central courtyard surrounded on all sides by rooms. There is generally one entrance door facing east, north or west. An entrance door facing south is considered inauspicious. He keeps his cattle in thatched sheds. The rooms of the residential house serve also as store-house for farm stock and generally one or more rooms are reserved for this purpose.

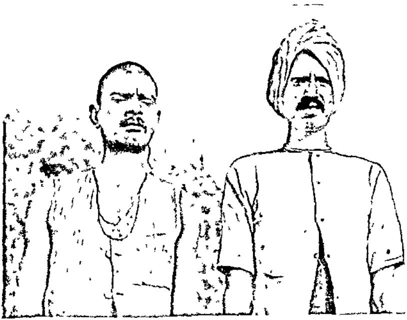
The diet of a Kurmi farmer is extremely simple. In fact it is doubtful whether he ever has a well-balanced diet, considered from the scientific standpoint. The breakfast consists generally of parched grain or *sattu* (gram and barley ground

together) with or without some *gur* The midday meal is generally *sattu* parched grain with *gur* and inferior milk products Occasionally he takes boiled rice or pulse chapatti also for the noon meal The night meal consists mainly of chapatti boiled rice and pulses occasionally also some home grown vegetables cooked w th oil or ghee Seasonal fruits such as mangoes *ber* etc are taken if available in the home orchard

The dress of the Kurmi farmer is very simple The man remains contented with a pair of *dhoties* one *banain* (vest) with half sleeves one *angoochha* (towel) one bed mat or *sujni* (coarse undersheet) and a *chaddar* or sheet during summer In winter he requires one double cotton *kurta* (shirt) and either a blanket or a quilt more to help him through the cold season

A Kurmi woman requires one pair of *dhoties* two jackets, one *sujni* and one quilt per year one *lahnga* (skirt) on ceremonial occasions or an ordinary *sari* with no underwear Children below five years are provided with two or three shirts and a cap For ceremonial occasions they generally prefer to keep finer clothes

The amusements of Kurmis are also very simple The Kurmi children play different games such as *kabaddi dola pati chikia dudari* (all team games) *gulli danda* (tip cat) *goli* (marbles) wrestling *dund baithaks* (physical exercises) and so on The adults generally sit together in a *chaupal*—an open thatched room—and chat in the afternoon and after work at night The recitation of the Ramayana local songs (*Birha Lorik*) and also story telling are common features of amuse ment On the days of religious festivals they attend local melas and fairs of whicl there are plenty



Typical Bundelkhand Cultivators

A Bundelkhand Cultivator and his family

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

4. THE BUNDELKHAND CULTIVATOR

BY

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Although the Bundelkhandi may not appear at all out of place in many parts of Central India, in the United Provinces he is a type somewhat apart. But if the countryside which produces him is compared with the rest of the province some differences in the man are only to be expected.

Geologically Bundelkhand is a piece of Central India, the natural features of which have little in common with the remainder of the province in which it is included. Here are no extensive plains of rich alluvium, watered by slow-flowing rivers, but undulating expanses made up of soils widely varying in character and of quite another nature and origin. In such a country, with its confused and rocky hills, its fast-flowing streams, lined usually with a maze of ravines, it is not surprising to find an agriculturist and a system of agriculture distinct from that of the remainder of the province.

Though subject in a general way to the same vicissitudes of life as the average cultivator of Northern India, historic, social, and climatic conditions have combined to produce here a tiller of the soil, whose outlook on life is sufficiently distinct to appear a little foreign to other cultivators of the same province.

(As a cultivator he has a reputation for being somewhat lazy and easy going; as a man, a cheerful optimist relying largely on custom and even superstition to guide him.) Nevertheless, he has developed a system of agriculture, which deals quite effectively with the cultivation of the varying types of soils under the difficult weather conditions which are his heritage, for nature has not been too generous to him. Historic conditions too have been against him. The Mughal, Maratha, and Bundela invasions may have been forgotten, but a sense of security is a thing of slow growth. Enterprise moreover is not encouraged where crops are largely at the mercy of the fluctuating seasons, where in favourable years little is required to secure average crops, but in others the most industrious husbandry often fails to ward off disaster.

His agriculture is therefore of the extensive type Proper soil preparation has to give place to hurried tillage and single crops to mixtures like gram and wheat and gram and linseed or even gram linseed and wheat in the *rabi* and *til* and *arhar* or *juar* and *arhar* in the *kharif* In the hope of striking a lucky combination of a large sown area and a favourable season more land is farmed than can be properly controlled with the man and bullock power available These conditions are well suited to the *kans* weed which in many areas takes a heavy toll and, spreading fastest in the seasons most favourable for crops robs the cultivator of most in those very years when it would be expected that he would be able to put a little aside as a reserve

It is true that the Bundelkhandi has methods for dealing with this pest But they are extensive too If a *kans* infested area is left for grazing for about fifteen years or flooded with water for a season or two much of the *kans* is destroyed but not for him the method of direct attack with a *phowra* (spade) His natural distaste for the *phowra* is shewn again in the comparative lack of bunds to prevent the run off of rain water which in his retentive *mar* and *kabar* soils and undulating contours would go far to mitigate the ill effects of badly distributed rainfall and loss of fertility by erosion

With cattle his ideas also run on extensive lines Status and wealth are in many areas largely judged by numbers which extensive grazing facilities do much to encourage With fluctuating seasons cattle share with their owners the experiences of both want and plenty In good seasons when grass is to be had for the cutting *juar* stalks can be seen left uncut in the fields though they may prove an infernal nuisance and clog up the plough and *bakhar* (blade harrow) when the land is being prepared for the succeeding crop Where such practices prevail a cultivator has only himself to blame if he earns a reputation for indolent optimism

In hard times however the Bundelkhandi can make the best of the scanty resources at his disposal and though he may lack in persistence and moral courage in physical pluck he is not wanting His work is usually planned to meet his immediate needs and a high value is set on leisure Display is not one of his failings but on occasions as at marriages he is as inclined to indulge in improvident extravagance as do cultivators in many other parts of India

His diet is simple and though coarse appears both satisfying and nutritive *Juar* is his staple food in winter but wheat and gram (*bejhar*) take its place in summer With *mahera* i e crushed *juar* and buttermilk *gur* and *malua* fruit) *mung* and *arhar* he is able to add variety and other nutritive elements to his diet Brinjal onions and chillies are his chief vegetables In ghee and milk he is probably better off than cultivators in many other parts of the province as extensive grazing areas permit of cattle, of somewhat low quality to be kept in rather considerable numbers

His home surroundings have an appearance of both comfort and happiness. The house, usually two or three-roomed, though low, is substantially built, often brick and stone as well as mud being used in the walls. Both house and courtyard walls are roofed with red tiles. The doors are particularly substantial, and characteristically low in height, a fashion probably dating back to the stormy days when the countryside was subject to visitations of marauding invaders, but now explained as a custom which makes anyone entering first bow as a sign of respect. About the houses is an air of cleanliness and neatness which does credit to the womenfolk responsible for them. On each side of the entrance is a neatly made platform regularly plastered every *Amawas* (New moon), and *Purnama* (Full moon). Here the family gather and enjoy much of their leisure in chat with their neighbours.

Besides being responsible for the cultivator's house, the Bundelkhand woman shares much of the burden of the work in the fields, where, on ordinary days, her characteristic red *dhoti* gives to the ever-changing rural setting, a splash of colour which, on high days and holidays, is further heightened by a red *chadder* and *lahnga*.

With heavy *painjana* (bangles) on her ankles, made usually of brass or zinc, hollow and carrying loose cooper balls inside them to produce sound, she usually has music of sorts wherever she goes. This heavy gear which adorns the women's ankles, and the men's heavily soled leather shoes with their flaps and turned up toes, made to give real protection from the thorns and stones, have earned for the Bundelkhandi considerable distinction in foot-wear. This shoe, made in pieces, all of which are separately replaceable, is definitely practical in its construction, though so heavy that the economically-minded often prefer to carry them wherever enough smooth going permits.

The Bundelkhandi's future is not without its brighter prospects. His countryside is faced with no problems of over-population. There is little pressure on the land, even in the canal-irrigated areas. In his soil is undoubted wealth waiting to reward the industrious. It is a pity that the Bundelkhand's virtues are so largely negative ones. His country needs a persistent and positive type of agriculturist, who can set a course of land development, and stick to it, no matter the weather or the seasons. It calls for men willing to put muscle into measures to conserve the soil to stop the drain which wash and erosion take of its wealth. For centuries it has been asked to respond to hand-to-mouth and pauperised systems of farming and it is hardly to be wondered that its soils now respond somewhat grudgingly. But the Bundelkhandi is slowly learning that his extensive systems do his soils no good, and that in irrigated areas he often wastes both labour and water, and slowly he is becoming aware that the response of the land to the sunshine and the rains, fickle as the latter may often be, is somewhere proportionate to the fertilizing material and the cultivation he is prepared to put into it.

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A NOTE ON COLLECTION AND CULTIVATION OF MEDICINAL PLANTS

BY

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DURING the last twenty five years a number of drugs of Indian origin have assumed importance which they did not possess before especially from the point of view of foreign trade Several manufacturing firms established in India use the raw material produced in this country in the manufacture of finished products Although India is exporting some of its crude products to foreign countries, she is still importing large quantities of crude drugs for its internal consumption It is a matter of very great concern that the raw materials collected in this country are often not up to the required standard and not only does the fair name of India suffer as a producer of unreliable material, but there is considerable economic loss Indian *Ephedra* for example came into prominence ten years ago from the point of view of the foreign trade but soon fell into disrepute, and we have to thank ourselves for practically the total extinction of the foreign trade in this drug Investigation into the causes which led to this state of affairs came too late to stem the slump in the trade in this commodity

If drugs of standard quality can be supplied we feel confident that in spite of all that has happened there is a promising future for the expansion of the export trade and internal demand It is our object in this paper to draw attention to some of the points which the collectors of medicinal drugs growing in a state of nature, and the present and the prospective cultivators should bear in mind in order to obtain good quality of the standard material We also propose to indicate how those carrying out investigations in this connection can improve the existing state of affairs

COLLECTION OF DRUGS GROWING WILD

It is a matter of common knowledge that there is a good deal of variation in the active principles in different organs of a plant and in different seasons in the

same organ of plant. What is not realised by many collectors and others is the fact that the same organ at the same time will show remarkable differences in the contents of its active principles. For example, the young and the old leaves on a plant will show considerable variations, and unopened and opened flowers will likewise differ despite the fact that they are collected at the same time. The interest of the unskilled labour employed for collecting is to collect the maximum amount of material in the minimum time since it is a common practice for wages to be paid according to the weight of the material collected. If, however, strict control is to be exercised, the out-put of the collectors will be naturally less, so they must be paid more and according to the quality of the material gathered. This can be done easily because, if the quality is good, better prices will be obtained which will not only compensate for the extra cost of labour but will also bring more to the producer. It must be understood that in the production of the finished product the cost of the raw material is not the only consideration for the manufacturers. Considerable expense is incurred on account of solvents, chemicals, personnel employed in the manufacturing process, packing, labelling and marketing. It will thus be seen why the manufacturers would be glad to pay more for the drug which is up to standard so far as the active principles are concerned.

No hard and fast rules can be laid down with regard to the time of collection of drugs, but where detailed information is not available the following general rules for the collection of material should be observed. The reason of this is that in many cases it is not known exactly when the active principles attain their maximum quantity and research is necessary to work out this factor in many of even the common and important medicinal plants :—

1. Roots, rhizomes and bark should be collected in late autumn or early spring.
2. Leaves, when photosynthetic processes are most active, which is usually about the time of development of flowers and before the maturing of fruits and seed.
3. Flowers, prior to or just about the time of pollination.
4. Fruits, near the ripening period, *i.e.*, fully grown but unripe.
5. Seeds, when fully mature.

Cultivation of drugs

It has been stated that drugs should be collected at proper stages of development in order to get the maximum amount of the active principles, but in some cases it is not possible to exercise this control. For example, some of the plants are gathered in forests difficult of access and they are neither gregarious nor plentiful and, therefore, difficult to collect at the proper time. In such cases, it may be worth while to bring them under cultivation. This should be done after mature consideration and after careful investigation of the suitability of soil and climate

for producing active principles of standard quality Investigations of this kind are laborious and expensive and beyond the means of private individuals They can only be undertaken by Government organisations such as the Forest Department or the Department of Agriculture In such investigations the objective should not be simply to grow the plant but also to find means to improve the quality of the active constituents There are many examples where the active constituents of plants growing in a state of nature have improved by proper cultivation India is so rich in its resources of drugs growing in a wild state and the labour is so cheap that unless a better yield of the active principles is obtainable under cultivation it will in many instances not pay to cultivate them This however does not imply that a plant which is found growing wild in some parts of the country should not be cultivated in another part if there is demand for it On the contrary cultivation may be necessary merely on the ground of obtaining an increase in the active principles besides other economic considerations

We will now consider the question of those drugs which are not found in India or the exotics which have been introduced Either the finished products of these drugs are imported into India or the raw material is obtained by agencies abroad. *If it is considered desirable to cultivate medicinal plants in this country careful* trials should be carried out by Departments of Agriculture to ensure that good quality can be produced before the agriculturists can take it up It is a matter of regret that such experiments are not often carried out on proper lines Often seeds are sown the plants grow up blossom set seeds and die without the investigation required at various stages Seeds are collected and the same thing is repeated the following year In the case of perennials sometimes a bed and sometimes a single plant tells its tale of neglect In other cases attempts are made to increase the yield per acre by selection or breeding but no attempt is made to determine how and at what stage the maximum yield of active principles could be obtained In a few instances excellent work has been done in this connection For example the Agricultural College Lyallpur has by selection succeeded in obtaining a larger inflorescence of *Plantago ovata* Forsk and consequently a larger number of seeds per plant In the Forest Research Institute at Dehra Dun cultivation of a few plants has been tried on proper lines

Drug cultivation is a problem from which spectacular results cannot be expected unless experimentation and research on proper lines is carried out for prolonged periods *Unless the raw materials are up to the required standard* as far as active principles are concerned they cannot be used will have no demand and therefore cannot be a financial success

Drugs that are cultivated for use in the Ayurvedic and Unani systems also need proper attention Rigid rules about the time and manner of collection of a particular plant or parts of plants are laid down in books of these systems which

show that old physicians were aware that only under certain conditions is the plant therapeutically active. Unfortunately the present-day collector does not take these instructions seriously.

RESEARCH ON DRUGS

We have stressed that the medicinal plants, whether obtained from a state of nature, or whether cultivated should have the requisite quantity of active principles in them. We will now say a few words as to how this can be obtained :—

1. Proper identification of the species is the first important step and if there are several varieties and forms of the same plant, each one of these should be carefully examined in order to determine which gives the best yield of active principles. Sometimes light can only be thrown on this aspect of the problem by extensive work in the field. For example, *Artemisia* from Kashmir and Kurrum could never have reached the present high standard of active principle content if it was not for the patient and careful work in the field. There are two forms of Kurrum *Artemisia maritima* Linn. In the early stages of growth one has deep reddish stems and the other greyish. The stems of both turn brownish at the time of maturity, but it is the form with deep reddish stems in the early stages that contains santonin and not the other. There is absolutely no other botanical difference between the two forms. The differentiation of these forms defied even skilled botanists for a long time and considerably hampered the progress of the santonin industry in India till the field work brought this fact to light. This is a very remarkable example of the fact that even the slightest differences in a plant may reveal so much unexpected differences in the content of active principles.

2. In the study of the active principles in a particular organ of the plant, for example the leaves. it is not only essential to examine them at different seasons of the year, but it is necessary to study the younger and older leaves from different regions of the plant, simultaneously. Almost always some difference will be found to exist between the various stages of growth of a particular organ although collected at the same time and from the same plants. Thus the younger leaves at the ends of the branches and tops give results different from the older ones. If care is not taken in collecting samples, there may be different proportions of young and old leaves in different samples and the result of analyses will be confusing especially if the variations are very great. It is only by careful sample collection and testing that it is possible to eliminate the poor quality growth stages collection of which will not be advisable.

3. In making comparative analyses, when one plant does not yield sufficient material required for analyses, for example while studying the effect of sun and shade drying, it is advisable to collect samples from individual plants separately and divide each into two parts. Portions of each should then be mixed to constitute one sample while the remaining halves mixed together would form the other sample. This gives more accurate results and eliminates the differences in the content of active principles present in individual plants. If more than two samples

are required for comparative purposes each plant can be divided into the desired number and then mixed

This indicates the importance of sampling in the assay of drugs The question of grading is equally important and must not be lost sight of especially if the drugs are meant for commercial purposes

4 In addition to the above, the seasonal variations, climatic and altitudinal effects, method of drying effect of decomposition of the raw material which is sometimes unavoidable especially when dealing with large quantities, effect of storage and any other point which might arise in the case of any special drug should be carefully studied

GENERAL REMARKS

Once all these aspects have been studied a judicious analysis of the results is necessary to transform the strict scientific results into commercial possibilities Until this is done it will not be possible to exploit fully the resources of wild drugs nor will it be possible to determine what plants can be successfully cultivated from the point of view of commerce The plants which are now thought to be unsuitable for cultivation because they bring insufficient return to the cultivators but do not definitely cause a financial loss should be properly investigated in the light of the above observations They must be cultivated by the Departments of Agriculture in their experimental farms and thoroughly studied before they can be definitely abandoned or adopted for the purposes of cultivation by the agriculturist Some of the Provincial Departments of Agriculture are cultivating the medicinal plants and there is no reason why others, who are not doing so at present, should not devote some attention to this important aspect The samples should be carefully selected and proper records of analyses kept with a view to proper investigation While the actual cultivation of drugs for experimental purposes and on a commercial scale is primarily the concern of the Departments of Agriculture and Forests the resources of the Medicinal Plants and Food Poisons Inquiry are always available to them to carry out chemical analyses, tests and advice on any points which may arise It may be noted here that some of the institutions and departments are experimenting on too many medicinal plants with the result that hardly any one of them receives the essential thorough study Experimental cultivation of a large number of plants is certainly to be encouraged but only a few of these should be selected for intensive study at a time It would be better to grow one important plant and thoroughly study it from every point of view than to grow ten plants and not study them thoroughly

There is another point which must be emphasised It would be no use trying to cultivate such plants as ephedrine yielding *Ephedra*, santonin yielding *Artemisia*, *Saussurea lappa* C B Clarke, etc , in the plains They are inhabitants of higher altitudes and cooler climates and may not adapt themselves where these conditions are not obtainable Such cultivation may of course be done for academic purposes and it will be seen that many difficulties will arise in raising the plants

even under expert care and more often than not they will be found unsuitable for cultivation on a larger scale. Our experience is that the energy spent in this direction will not be usefully spent and it is not likely to bring results of practical value as would be the case, if proper selection is made beforehand. Similarly, there is a greater likelihood of plants of warmer regions thriving better in environments which are more akin to their natural habitat. In short, plants likely to be suitable for particular localities are those which thrive in nature under similar environmental conditions.

Lastly we would like to emphasise that there are some plants which should and could be cultivated as regular crops, such as *Plantago ovata* Forsk. Suitable places for others would be the ridges among the cultivated fields and any other waste land which may be available. The main idea of cultivating medicinal plants is in most cases to provide additional income to the agriculturists and not to replace their normal crops.

The following is the list of plants* which, in our opinion, are likely to be successfully cultivated in India, if proper care and attention is devoted to them. The popular names and the part or parts of the plants used are also indicated and localities suitable for the cultivation of each of these have been given. Besides their medicinal value, some of these plants have other economic uses and these should not be overlooked. Further studies in connection with medicinal plants, which may be profitably grown by the agriculturists, are in progress and the results will be published in due course.

1. *Anacyclus pyrethrum* DC. (The Pellitory of Spain)—Roots.

The plant is indigenous to north Africa and has been introduced into south Europe but has not yet been reported as grown in India. Large quantities are imported into India, chiefly from Algeria. It may be tried in both the East and West Coasts of India near the sea coast. There is quite a large demand for this drug in the indigenous systems of medicine as a cordial and stimulant. It is also chewed as sialagogue and is used against toothache.

2. *Atropa belladonna* Linn. (Deadly Nightshade)—Leaves, roots.

The plant is found wild in the Himalayas from Simla to Kashmir at an altitude of 6,000 to 12,000 ft. Considerable quantities could be profitably grown in suitable situations. It would grow best in the western Himalayas at altitudes between 6,000 to 8,000 ft. in places where the soil is porous, containing sufficient mineral constituents (potash, soda, lime, etc.) and drainage is good. Not much manuring is required. There is a large demand all over the world and it is used in medicine as a sedative, antispasmodic, anodyne and mydriatic.

3. *Cassia acutifolia* Delile. (Alexandrian Senna of commerce)—Dried leaves and dried ripe fruits.

This plant is a native of Nubia, of Kordofan and Sennaar, and other parts of

*Those marked with asterisk are used only in the indigenous systems of medicine.

Africa It is likely to grow in similar localities as described in case No 4 and has the same use

4 *C angustifolia* Vahl (Indian or Tinnevelly Senna)—Dried leaves and dried fruits

The plant abounds in the Yemen and Hadramant in Southern Arabia, and is also found on the Somali coast It is cultivated in Tinnevelly and Madura in the south and in Poona in the Bombay Presidency The Indian product is generally considered to be of a better quality than the Arabian variety which grows wild There is room for further extension of its cultivation, both for internal consumption and export The plant is likely to thrive well in places with light rainfall, say about 35 in per year and having equable temperature—the maximum of about 95°F and the minimum not going below 50°F in winter The soil should be of a grey alluvial kind, consisting of a mixture of sand and clay It is used in medicine as a purgative, and as a household remedy for the same purpose

5 *Chrysanthemum cinerariaefolium* Vis Syn *Pyrethrum cinerariaefolium* Trev
6 *Ch coccineum* Willd Syn *Ch roseum* Adam, *Pyrethrym roseum* Bieb } Pyrethrum (1)

The flower heads are in very great demand all over the world, as an insecticide So far, they have been experimentally grown in India at an altitude of 5 000 ft in Kashmir and also at Dehra Dun in the United Provinces and the top of Pareshnath hills in Bihar Temperate outer Himalayas would appear to be most suitable, but they may also be tried in the Nilgiris and lower hills of Manipur (Assam) No 5 is commercially more important at present There is likely to be a very large demand in India for this drug as a larvicide for mosquitoes (For detailed information see Pyrethrum Flowers', Gnadinger, C B , 1936)

7 *Citrullus colocynthis* Schrad (Colocynth)—Dried pulp of the fruit.

The roots and whole fruit without seeds are commonly used in India , the dried pulp of the fruit is officinal in British Pharmacopoeia The plant grows wild in waste tracts of north west, central and south India and the fruit is collected from plants which grow wild on certain desert tracts of north west India Large quantities of the fruit are, however, annually imported from Europe, Arabia and Syria In Spain and Cyprus the " colocynth apples " are actually cultivated for purposes of export The plant will do very well in the plains of north west central, and south India It is in quite a large demand as a purgative both in the Western and indigenous systems of medicine

8 **Crocus sativus* Linn (Saffron)—Stigmas

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*Those marked with asterisk are used only in the indigenous systems of medicine

(1) Since this article was sent to the press, pyrethrum flowers cultivated at Baramulla, Kashmir, have been chemically examined at the School of Tropical Medicine and found to contain 1 02 per cent of *pyrethrins* This compares very favourably with foreign grown stuff Biological tests are in progress and the results will be published in due course

It is grown in France, Spain, and Italy, but most of the Indian supply comes from France, China, Kashmir, and a small quantity from Iran. In Kashmir it is grown at Pampur near Srinagar at 5,000 ft. It prefers moderately dry and cool climate. It is used to some extent as a stomachic, antispasmodic, stimulant and aphrodisiac in indigenous system of medicine. There is, however, a large demand as a colouring and flavouring agent for foodstuff. Much more could be cultivated for internal consumption in India and for export purposes.

9. *Digitalis purpurea* Linn. (Digitalis)—Leaves.

It is a native of western Europe but is now extensively grown in many parts of the world. In India Digitalis cultivation in Kumaon and Kashmir has great possibilities. Although it does very well in the eastern Himalayas, there are difficulties of drying and storing in a wet climate. In Kashmir it is cultivated at Tanmarg at an altitude of about 6,000 ft. On the whole, places with lesser rainfall during early to mid-summer should be preferred. Several suitable places in the north-western Himalayas at altitudes of 5,000 to 7,000 ft. could be found where it would do well. It is used in certain heart conditions to increase the tone, excitability and contractility and the refractory phase of the cardiac muscles. There is quite a large demand for it. *D. lanata* Ehrh., which has been worked at the School of Tropical Medicine is less cumulative, rapidly slows the pulse rate by 50 per cent and less deteriorating in the Tropics than *D. purpurea*. It has been successfully cultivated in Kashmir.

10. *Eucalyptus globulus* Labill. (Eucalyptus)—Leaves for distillation of oil.

It is an Australian plant whose introduction into India has met with complete success on the Nilgiris and other hill ranges of south India. It may also be tried at elevations between 4,000 to 5,000 ft. in the north-west India. Above this altitude it is liable to suffer badly from snow. It is used specially in bronchitis as inhalation and also internally as an anthelmintic. In addition it has a large demand as an insect repellent.

11. *Eugenia aromatica* (Linn.) Baill
Syn. *E. aromatica* Kunze; *E. caryophyllata* Thunb.: *Caryophyllus aromaticus* Linn.—Dried flower buds. } Clove.

Cloves met with in Indian bazars are often old and inactive. Those suited for medicinal purposes should have a strong fragrant odour, a bitter spicy pungent taste, and should emit a trace of oil when pressed between fingers. It is a native of Moluccas and thrives in a moist tropical climate preferably in an island. It has been cultivated in southern India in the Government gardens, Burliar, and central Travancore, especially in Koni, with some success. It is likely to do well in similar places. It requires certain amount of sand in the soil to reduce its tenacity. The tree naturally likes a volcanic soil and a sloping position. It is

used in medicine in dentistry and is also in demand in the indigenous systems of medicine It is largely used as condiment and for other household purposes. There is a very large demand in India

12 *Ferula alliacea* Boiss
Syn *F Assa foetida* Boiss et Buhse (non Linn) { Asafoetida—Oleo resin obtained by incision from living rhizomes of the plant

The plant is found in eastern Iran and in Khorasan It grows on stony arid soil up to an altitude of 7 000 ft It might be successfully cultivated in India on the hills of North West Frontier Province It yields the kind of *hing* much preferred as condiment in India and is used in the indigenous systems of medicine for a variety of purposes such as stimulant carminative and antispasmodic and in hysteria etc , There is a large demand for it

13 *F foetida* Regel (Asafoetida)—Oleo resin obtained by incision from living rhizomes of the plant

The plant grows in southern Turkestan and in sandy deserts and arid hills of Eastern Iran in Khorasan and in the neighbouring parts of Afghanistan near Herat Its cultivation may be tried in similar areas as in the case of No 12 at an altitude between 2 000 to 4 000 ft in the valleys This is the asafoetida of European commerce and is used in medicine as sedative in hysterical conditions as a carminative and by mouth and enema in tympanitis There is a sufficiently large demand

14 *Gaultheria procumbens* Linn (Gaultheria Wintergreen)—Leaves for distillation of oil

The plant is a native of America It is likely to grow well in Nilgiris Travancore and Assam between 4 000 to 7 000 ft in somewhat moist and shady places There is a fair demand and it is used in rheumatism and neuralgia as an embrocation

15 *Gentiana lutea* Linn (Yellow Gentian)—Roots

This plant is a native of alpine and sub alpine regions of south Europe It may well be tried in the temperate Himalayas at an altitude of 5 000 to 9 000 ft There is a fairly large demand and it is used as a stomachic and bitter tonic

16 *Glycyrrhiza glabra* Linn (Liquorice)—Decorticated root, subterranean *stem*

It is a plant of Mediterranean region and is cultivated in Italy France, Russia Germany Spain China etc It is known to be grown in Kochla Thana in Baluchistan Drosh in Chitral and recently experimentally grown at the Agricultural College Lyallpur The areas where its cultivation may be successful are the temperate regions of the Himalayas and it may also do well in the hill districts of South India There is a large demand for this drug It is largely used in both western and indigenous systems of medicine and is used as a tonic, laxative and for cough.

17. *Hyoscyamus niger* Linn. (Henbane, Hyoscyamus)—Leaves and green tops.

Grows wild in India and does well in the north-west temperate Himalayas at an altitude between 5,000 to 9,000 ft. There is a moderate demand for it for medicinal purposes. It is used as a sedative and hypnotic. It is also used in the indigenous systems of medicine.

18. *Ipomoea purga* Hayne. (Jalap)—Tubers.

It is a native of the Mexican Andes, occurring at altitudes between 5,000 to 8,000 ft. In the localities where it grows rain falls almost daily, and the diurnal temperature varies from 60° to 70° F. It flourishes in shady woods in a deep rich vegetable soil and is now being cultivated in Europe. The plant has been grown in the Nilgiris and would do well in south Indian Hills and eastern Himalayas at an elevation of 3,000 to 6,000 ft. At higher levels the tubers are liable to be destroyed in winter unless protected from frost. There is a fair demand in India as a mild purgative.

19. *Lavendula spica* Cav. (Lavender)—Fresh flowering tops for distillation of volatile oil.

For places recommended for cultivation—See No. 20.

20. *L. vera* DC. (Syn. *L. Officinalis* Chaix) (Lavender)—Fresh flowering tops for distillation of volatile oil.

It is a native of south Europe and Mediterranean shores, extending into western Africa. It is extensively cultivated in England. It was tried in the Government Botanic Garden, Nilgiris, but proved a commercial failure. There seems no reason why it should not do well on the temperate regions of the Himalayas. When about four years old it yields the best otto, and is said to be improved by keeping back the flowering. Both Nos. 19 and 20 are used in medicine as flavouring agents and as carminative but there is a large demand in perfumery.

21. *Lobelia inflata* Linn. (Lobelia)—Dried aerial parts.

This is an American species and may well be tried in the Nilgiris and Travancore between 3,000 to 7,000 ft. It may also do well in the eastern Himalayas. There is a moderate demand in medicine. It is used as an antispasmodic in asthma and whooping cough and as an expectorant.

22. *Mentha piperita* Linn. (Peppermint)—Herb or better, perhaps, leaves during budding and flowering stages for distillation of volatile oil and manufacture of menthol.

The plant is largely cultivated in some foreign countries, *e.g.*, United States of America and England. Experiments were carried out many years ago with a certain degree of success in the Nilgiri gardens. Methods of planting, cultivating, harvesting and distilling have been worked out through years of trial and experiment in other countries and could easily be taken advantage of in India

It can be easily grown as a garden plant in temperate climate According to a recent report by the Ministry of Agriculture, London, any light calcereous soil friable sandy loams or gravels may be used for cultivation of mint It is used as a carminative and to disguise the taste of evil smelling and unpleasant drugs As a flavour in confections and dentifrices and other household purposes also it is used to a very large extent

Japanese oil which is prepared from other species of Mentha—*M arvensis* Linn (var *piperascens* Holmes) or from *M canadensis* Linn (var *piperascens* Briquet) is also largely imported but is admittedly inferior to the English The Japanese oil, however is rich in menthol content The future of the cultivation will depend upon the rate at which the synthetic menthol is being produced and boomed in the market

23 *Myristica fragrans* Houtt (Nutmeg, Mace)—Nuts, aril

The plant is found wild in Moluccas It is cultivated in India to a very limited extent and did well in the Government Gardens of Burliar in the Coonoor Valley on the eastern side of the Nilgiris and Courtallum hills further south The best soil for the nutmeg tree is a deep rich loam with good drainage, the climate should be hot and moist It is likely to grow well near the sea both on the East and the West Coasts of South India, especially the latter It is not much used in medicine but the volatile oil enters into several important and widely pharmacopoeial preparations, and is also used in indigenous systems of medicine as stimulant, carminative and tonic, etc It is extensively used in perfumery. It has a widespread use as a condiment in India and in European cookery

24 *Myroxylon toluiferum* H B and K (Tolu)—Balsam obtained from incision of bark

It is a plant of tropical America and may do well in south India and eastern Himalayas at places with fairly equable temperatures and at altitudes between 1,500 to 3,000 ft It is used for flavouring and improving the taste of liquid medicines It has a large demand in medicine

25 *Physostigma venenosum* Balf (Physostigma)—Seeds

This is a plant of tropical Africa and in India it may be tried in the plains of several provinces It has a moderate demand in medicine as a myotic and is also used to increase gastric and intestinal peristalsis

26 *Piper cubeba* Linn f (Cubebs)—Dried full grown, unripe fruits

It is a native of Java and the Moluccas, and has been successfully cultivated in Mysore The plant grows well up to an altitude of 1,500 ft and likes a warm and moderately moist climate It will probably do better in South India and may do well in certain parts of Bengal It has a moderate demand in medicine as a urinary antiseptic, but there is a fairly large demand in indigenous systems of medicine There is also some demand as a spice

27. **Plantago ovata* Forsk. (Isapghul) } Seeds.
28. *P. psyllium* Linn. (Psyllium) }

These two plants would do very well in the plains and hills throughout India up to an altitude of 6,000 ft. or so, preference being given to places with not too high rainfall. No. 27 is used to a large extent as a household remedy in dysentery and diarrhoea and for functional derangement of digestive organs. No. 28 has recently come into use as a popular laxative and demulcent in foreign countries.

29. *Polygala senega* Linn. (Senega)—Roots.

It is not a native of India nor is cultivated here. It may be tried in the temperate Himalayas at 4,000 to 7,000 ft. and it may do well at somewhat lower altitudes also. Places with too much rainfall are not suitable. There is a small demand for this drug in medicine as an expectorant.

30. *Psychotria ipecacuanha* Stokes. (Ipecac)—Roots.

The plant has so far been cultivated in India at Mungpoo in Bengal and at Burliar and Kallar gardens in south India and at Mergui in Burma. Everywhere the plant thrived well but specially so in Burma where it was put on river silt. The climate suitable for cinchona also suits this plant. It may be tried in eastern Himalayas at places where variations in temperature are small and where land might be had along the river banks. There is large demand for amoebic dysentery and as an expectorant.

31. *Rhamnus purshiana* DC. (Cascara sagrada)—Bark.

It is likely to do well in the temperate Himalayas with moderate or even low rainfall. There is a large demand in medicine as a purgative.

32. *Rosa centifolia* Linn. (Hundred leaved or Cabbage rose) } Flowers.
33. *R. damascena* Mill. (Damask or Persian rose) }

Both these species are cultivated in gardens all over India but No. 32 is, at any rate, the more common. Plains of northern India are most suitable and places with slightly sandy soil are preferred. There are some places, for example, Patna, Ghazipore and selected areas in the Punjab, where it is known to do very well and large areas are covered with it. Cultivation on a larger scale would be a paying proposition. Rose water is used in medicine as a flavouring agent. The petals or the rose water is also used in the indigenous systems of medicine. There is a very large demand in commerce for the preparation of oil or otto and rose water.

34. *Rosmarinus officinalis* Linn. (Rosemary)—Fresh flowering tops for volatile oil.

It is a plant of the Mediterranean region and is reported to be cultivated in the gardens in India. It may be tried in the plains with equable climate but is likely to do better in the temperate Himalayas with dry to moderately moist

* Those marked with asterisk are used only in the indigenous systems of medicine.

climate Preparations of Rosemary are chiefly employed externally as ingredients of stimulating liniments It is also employed as an adjunct in many perfumes, *e g* Hungary water and Eu de Cologne

35 **Saussurea Lappa* C B Clarke (Costus, Kuth)—Roots

The plant naturally occurs on the moist, open slopes, surrounding the valley of Kashmir and in parts of basins of the Chenab and the Jhelum It is being cultivated to some extent in the village Koksar in Upper Chandra valley in the Punjab Cultivation on a large scale could be started in the western Himalayas at an altitude between 8,000 to 10,000 ft It is likely to be one of the most paying crops It is used in asthma and in preparations of stimulating ointments Its use as a protector of warm clothes from attacks of moth and other vermin is well known It is exported in enormous quantity to China, where it is used as incense Three to four years' old roots are marketed

36 *Strophanthus kombe* Oliver (Strophanthus)—Seeds

It is an African species and is likely to do well in the moist tropical regions of south India It is possible that it may do well in drier places also There is a fair demand It is used to increase the tone, excitability and contractility of cardiac muscles

37 *Styrax benzoin* Dryand (Benzoin)—Balsamic resin obtained from incised stem

The plant has been known to be successfully grown in the Government Gardens, Bangalore It will probably do well in several other places in south India It is used as an inhalent in chronic inflammation of mucous membrane (bronchitis) and as an antiseptic for cuts and wounds There is a fairly large demand

38 **Swertia chirata* Ham (Chirata)—Whole plant

It grows very well in the temperate Himalayas between 4,000 to 7,000 ft It is used as a bitter and stomachic and there is a fair demand

39 *Urginea scilla* Steinheil (Squill)—Bulbs (Syn *U maritima* Baker)

This plant grows on the shores of the Mediterranean It may be tried in places where Indian scillas grow, that is, in sandy soil near the sea or in the drier hills of the lower Himalayas up to an altitude of about 3,000 ft There is a fair demand It is used in medicine as an expectorant and general diuretic

40 **Viola odorata* Linn (Sweet violet)—Flowers (also the whole herb)

It can be grown in the plains but more suitable situation would be the temperate Himalayas and Nilgiris between 3,000 and 6,000 ft Places with drier climate should be preferred There is a large demand in the indigenous systems of medicine for a variety of purposes such as, astringent, demulcent, diaphoretic, diuretic and in biliousness and lung troubles Very little of the genuine stuff is available in the market

* Those marked with asterisk are used only in the indigenous systems of medicine

NSECTS IN RELATION TO DISEASE OF DOMESTICATED ANIMALS*.

BY

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INTRODUCTION

THE customary precedence given by the average individual to the curative ıspect of disease control over the science of preventive medicine and prophylaxis ɔonstitutes a remarkable instance where the normal sequence of human endeavours s designedly altered in the conviction that such a course makes for expediency in the matter of ensuring a better standard of health and efficiency. While in every other field of his conflict with the elements of nature, the human subject has garnered the fruits of his age-long experience in the numerous forms of protective device that have time and again served as bulwark against their aggression, it is in the field of disease alone affecting either himself or his live-stock that he frequently betrays a curious lack of foresight and defensive instinct and diverts the bulk of his efforts to fighting the enemy when it has already crossed his unguarded portals of entry and has even succeeded in making an inroad into the very interior. One thus notices the hapless stock-owner making frantic efforts to get his animal rid of this or that disease ' germ ' that has unaccountably invaded its circulating blood or of an army of fly maggots that have, in a mysterious fashion. made their appearance in an unsightly wound in its skin. Is he really so powerless, as he thinks himself to be, to prevent such aggression and is it merely given to him to be a silent witness to the damage that is being wrought and then to arrest its progress or repair it as best he can ? A reply in an emphatic negative was provided to this question when, in 1796, Jenner laid the foundation of the present-day preventive medicine by demonstrating the value of vaccination against small-pox. The principles of so-called ' jennerization ' have been extended to cover a wide field in both human and veterinary medicine, for, as is well known, the use of anti-sera and vaccines now constitutes a potent method for combating a number of diseases affecting man and animals. While the introduction of these products has thus registered a definite advance in the history of preventive medicine, one is apt to lose sight of the precise signficance of their protective value : they are not designed to ward off a disease-producing organism, but to prevent it from obtaining a foothold in the system of its host. The form of treatment envisaged

*This is the ninth of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

in this method may thus be designated as "neo therapy" being in essence a form of curative treatment having as its objective the annihilation of the disease organism before the latter has had time to proliferate and overpower its victim. Curiously the advantages of even this simple nip in the bud method although obvious enough do not as yet appear to have received their due share of recognition and one notices that the craze for nostrums continues unabated not only amongst the masses but also amongst the intelligentsia whose acquaintanceship with such products is not infrequently regarded as a measure of the extent to which they have succeeded in keeping themselves abreast of the more recent advances in the science of medicine

In so far as veterinary medicine is concerned however the cult of healing art has never been viewed with the same degree of favour as it has been in human medicine for the bulk of the work in this field has been directed to perfecting methods of prevention so that in this respect it must be regarded as the more rationalistic of the two in its outlook How this has come to be so is not far to seek for as Fleming has remarked the medicine of the lower animals differs from that of man in no particular so much perhaps as in the application it makes of utilitarian principles The life of the man is sacred but in the case of animals where there are doubts as to complete restoration to health and soundness monetary considerations generally decide against the adoption of remedial measures" The science of disease prevention as opposed to disease cure thus constitutes the very essence of veterinary medicine and assumes a paramount position for the stock owner whose concern for his animals is not so much dominated by ethical principles as by considerations of efficiency and usefulness As already indicated in this note this science largely consists at the present time in the application of products designed to destroy the disease organisms before they have obtained a foothold in the tissues of their hosts so that the millenium would be reached if measures could be devised to prevent live stock from acquiring them at all This brings us to a consideration of the mechanism whereby such organisms are acquired

HOW DISEASE PRODUCING ORGANISMS ARE ACQUIRED BY LIVE STOCK

It is now a well established fact that a great many of the parasitic and also a proportion of the virus diseases are transmitted through the agency of insects or ticks and this is why as remarked by Rosenau [1927] Entomology has become a vitally important subject so far as preventive medicine is concerned It has been computed that about one hundred diseases of live stock are transmitted in this manner and as has been pointed out elsewhere by the present writer [Sen 1934] the actual number of such diseases is likely to turn out to be far greater in view of the fact that the avenues of infection are numerous in the case of animals on account of the unprotected manner in which they are maintained

In the present note it is proposed to deal with only such common diseases

live-stock as are known or suspected to be transmitted by insects, for the bject of tick-borne diseases has now attained a dimension sufficiently large to erit separate treatment and will therefore be dealt with in a later communica- ɔn. For the information of readers not possessing an acquaintanceship with ⁊stematic Entomology, it may be mentioned that an insect is characterized by ıe possession of three pairs of legs in the adult stage and by the body being divided ıto three well-marked regions, namely, the head, thorax and abdomen. An dult tick, on the other hand, possesses four pairs of legs, whilst the head and the ıorax are fused to form what is known as the cephalothorax (Plate XVIII)

The methods by which diseases are transmitted by insects may be classed into wo broad categories : (1) mechanical and (2) cyclical. In the first method, the nsect merely plays the part of a casual porter and carries the disease-producing ›rganism on its mouth-parts or legs (Plate XVIII)—both of which are well adapted 'or this purpose—or other parts of its body and deposits it on wounds or abrasions ɔr on the mucous membrane of a healthy animal ; or, the organism may be directly inoculated by means of its mouth-parts, exactly in the same way as one would do in giving an infective inoculation by means of a needle, so that, in this last sense, ɑll blood-sucking insects may be regarded as potential carriers of disease. The organism may also obtain a temporary lodgment in the upper part of the digestive tract of the insect and the latter may regurgitate it, while feeding, on the body of the final host ; or, the organism may pass through the digestive tract and be voided in the faeces ; or, again, it may not normally pass out of the insect at all but may be acquired by the animal by the crushing or swallowing of the insect.

Under natural conditions, a common method of disease transmission is by the so-called " interrupted " feeding, where the infective insect, while engaged in the act of obtaining a meal of blood, is interrupted by the movement of the host and at once proceeds to complete the feed on a healthy animal of the same species. Similar conditions have been actually reproduced in the laboratory in order to test the possibility of certain diseases being transmitted in this manner, and in a proportion of these trials the results have been positive.

In the cyclical method of disease transmission, on the other hand, the causal organism, after being ingested by the insect vector, undergoes a series of developmental changes before it becomes again infective for a new host, as is known to be the case in the mosquito transmission of human malaria. It has, however, been repeatedly observed that such development is capable of being accomplished by an organism only in one or a very limited number of insect species, and it is the discovery of the actual species of vectors thus involved that constitutes one of the principal aims of research in both Medical and Veterinary Entomology. It will be readily realized that progress in this field is necessarily slow, inasmuch as it entails an intensive examination of the internal tissues of suspected vectors and the

prosecution of carefully controlled transmission experiments, and all this frequently assumes enormous proportions This is why the bulk of the existing knowledge concerning insect vectors of animal diseases relates to the mechanical as opposed to the cyclical, method of transmission, and it will also be largely the former category of diseases that will be dealt with in the section that follows

SOME COMMON INSECT BORNE DISEASES OF LIVE STOCK

It would hardly be possible within the compass of a note of this kind to deal even in outline, with the whole of the enromous volume of accumulated evidence on record pointing to the conclusion that it is through the intermediary of insect that a large proportion of the pathogenic organisms are acquired by live stock In what follows it is proposed merely to cite, by way of illustration, a few of the more important diseases in which insect vectors are known or believed to be involved For the sake of convenience, these diseases will be considered under four categories, depending upon the nature of the agents responsible for the causation and this will incidentally furnish an indication of the remarkably vari character of the rôle played by insects in their spread under natural condition

(a) *Virus diseases*[2]

1 *Rinderpest* —There is on record a good deal of presumptive evidence indicate that this most serious contagious disease of cattle is spread through intermediary of blood sucking flies The consistency with which the disease be reproduced by the sub inoculation of a minute quantity of infective blood is itself suggestive of such a possibility and to this may be added the observati brought forward by some recent workers to show that outbreaks of rinder frequently synchronize with the seasonal occurrence of the larger types of bi flies [Crawford, 1933] As a matter of fact, there are instances on record wl the disease has been experimentally reproduced through the bites of tsetse in Africa [Hornby, 1926] and of horseflies in India [Bhatia, 1935]

2 *Foul pox* —This is one of the few virus diseases which have been con sively shown to be capable of being transmitted through the agency of insects has been recently demonstrated that under experimental conditions fowl pox be readily reproduced through the bites of various species of mosquitos, som which are of common occurrence in India [Kligler, Mackenfuss and Rivers 1 In a few instances, these mosquitos have been found to remain infective for a a fortnight following a meal on diseased fowls It is noteworthy that the st fly has also proved capable of transmitting fowl pox one to fifteen days becoming infective [Bos, 1932]

(b) *Bacterial diseases*

3 *Anthrax* —The earliest experimental evidence of the transmissio anthrax through the agency of insects was obtained as far back as in the year

[1] The general features of the vectors mentioned in this and the following sectio indicated by diagrammatic sketches in Plate XVIII

[2] These diseases are caused by agents which cannot be seen under the microscope

hen Raimbert showed that the disease could be reproduced by the inoculation nto guinea-pigs of the crushed bodies of meat flies that had been fed on anthrax blood. Since that date, our knowledge of vectors concerned in the spread of this disease has steadily advanced, and of the more recent contributions in this field, mention may be made of those made by Morris [1918] in America, who succeeded in transmitting the disease through the agency of horseflies and mosquitos. The so-called carrion flies are also known to be not infrequently concerned in the spread of the disease under natural conditions, and this is only what is to be expected in view of their habit of breeding in carcases of animals, including those dead of anthrax. This was strikingly illustrated during the Great War when numerous cases of the disease occurred in animal subjects due to flies bred from infected carcases on the battlefield.

4. *Haemorrhagic septicaemia.*—Although no definite experimental evidence has as yet been put forward to prove the transmission of this disease through the agency of insects, there is a considerable amount of presumptive evidence on record pointing to the conclusion that, under natural conditions, the disease is conveyed by more than one species of biting flies, notably horseflies [Nieschulz and Kraneveld, 1929]. In view of the fact that the causal parasite of haemorrhagic septicaemia is a near relative of the bacillus of human plague, the possibility suggests itself, as already pointed out by Sen [1925], that fleas may also act as vectors of the disease.

(c) *Protozoan diseases*[1]

5. *Surra* (Trypanosoma evansi *infection*).—In relation to the question of vectors of animal diseases, the subject of surra has received by far the largest amount of attention from veterinary workers in India, the earliest observations in this field having been made as far back as in the year 1901, when Rogers brought forward some experimental evidence to prove that the disease was transmitted by the bites of horseflies. Rogers's observations have since been confirmed by a large number of other workers, not only in India, but also in the Philippines [Mitzmain, 1913] and Dutch East Indies [Nieschulz, 1930]. Of the Indian workers in this field, a special mention should be made of Cross and his collaborators [1922, 1923], who, as a result of an extensive series of experiments, came to the conclusion that the disease was capable of being transmitted by several species of horseflies, notably the one known as *Tabanus rubidus*, which is of very common occurrence in this country. At the present time, however, attention has been largely focussed on the possibility of the occurrence of a cyclical transmission of the disease on the analogy of what is known to take place in the

[1] The protozoa are 'unicellular' organisms and include the malaria parasites.

case of a similar condition (Nagana) in Africa although the indications so far available would appear to be against this possibility

6 *Pigeon malaria* —This disease although of less importance than the preceding ones provides a feature of special interest in that it represents the only instance of an insect borne protozoan disease of live stock in India where the causal parasite (*Haemoproteus columbae*) is definitely known to undergo a cyclical development in its invertebrate host which is a well known louse fly (*Pseudolynchia maura*) and is of common occurrence on pigeons in the plains of India The development undergone by the parasite in the fly occupies a period of about three weeks and at the end of this period but not before the fly becomes infective for healthy birds [Adie 1924]

(d) Worm diseases

7 *Bursati* —This well known equine disease which manifests itself in the form of tumours has recently been shown [Datta 1933] to be caused by a species of worm (*Habronema*) which is either identical with or closely allied to the parasite responsible for an analogous condition known as summer sores in certain other parts of the world It has been conclusively demonstrated that the causal parasite of this latter disease is transmitted by both the housefly and the stablefly in which it undergoes changes before becoming again infective for a healthy subject so that it is more than probable that the same two vectors are also concerned in the production of *bursati* in India In the final phase of its development in the tissues of its invertebrate host the parasite invades the mouth parts where it usually remains in residence until excited to activity by contact with a warm moist surface such as what occurs when the fly is sucking moisture from the horse and under such conditions it actively leaves the proboscis of the fly and invades the equine host

8 *Tapeworm of dogs* —This worm (*Dipylidium caninum*) which occurs commonly in the intestines of dogs and cats is transmitted by the biting dog louse (*Trichodectes canis*) and also by dog fleas (*Ctenocephalus felis* and *Ct canis*) The eggs of this worm are passed through the dog s anus and fall to the ground when they are ingested by the flea larva They now hatch into embryo tapeworms and these latter eventually develop into the so called 'cysticercoid' forms By this time the flea larva develops into the adult stage and it is by swallowing the infected adult flea that the dog or the cat as the case may be acquires the infection A similar cycle of development also takes place in the dog louse

Before concluding this section a reference should be made to a group of diseases in which insects do not play the rôle of transmitting agents as they do in the instances cited above but inflict direct injury on the host which in consequence may develop extreme unthriftiness and other symptoms indicative of a general loss of condition Examples of this are provided by the so called "lousiness" caused by a massive infestation of lice and 'myiasis', a term given

to the conditions brought about as a result of invasion by fly maggots of the skin, digestive tract, or rhinal and other passages of man and animals. As is well known to most stock-owners, such maggots, when present in large numbers in wounds or sores, may cause extensive injury by burrowing into the tissues. In this connection, it is worthy of note that the Indian bluebottle, *Chrysomyia bezziana*, has, unlike most other species of this class, the peculiar habit of breeding only in living tissues, instead of in carcases, and this accounts for the fact that it happens to be the commonest species of myiasis-producing fly in this country. By far the most important form of animal myiasis, however, is that caused by the ox warble fly (*Hypoderma lineatum*) and this has already been dealt with by the present writer [Sen, 1934, 2] in a previous article in this Journal.

Combating disease-carrying insects

The subject of combative measures against blood-sucking insects, as adopted in some of the progressive countries of the world, has already been dealt with elsewhere by the present writer [Sen, 1932]. Moreover, a consideration of these measures would be outside the scope of this paper, for, as its title indicates, its object is no more than to present facts illustrative of the importance of insects as carriers of some of the common diseases of domesticated animals in India. It would seem, however, that in relation to the general problem of combating the insect pests of live-stock, these facts might be relevantly elaborated to include an outline of the life-history of the insect vectors referred to in the preceding section, for it is on this knowledge that any rational method of control will have to be ultimately based, and, as pointed out by Rosenau [1927], "without an acquaintance of the life-history and habits of the insect host, there will be economic loss, wasted energy and disappointing results".

By far the largest majority of insects with which the stock-owner is concerned have, broadly speaking, the same type of life-history, their growth being marked by a series of remarkable developmental changes from the egg to the adult stage which are expressed by the term 'metamorphosis'. This is best illustrated in the case of a horsefly (Plate XIX). It lays eggs on vegetation overhanging water and these hatch into larvae which live an aquatic life, feeding and growing all this time (which may be several months), until they enter a quiescent stage and turn into pupae and these latter, after a period of about a month or more, transform into winged adults. The occurrence of these four stages—the egg, larva, pupa and adult—also forms an essential feature in the development of the mosquito, house-fly, buffalo-gnat and, in fact, of most species of flies and also of the flea, although a considerable amount of variation may exist in regard to their breeding habits. Thus, the housefly breeds largely in horse-dung and kitchen refuse, the stablefly in stable litter impregnated with urine, the bluebottle in carrion, the mosquito in accumulations of water, the sandfly in various kinds of earth materials, the buffalo-gnat in running streams and the flea in crevices of floors and under mattings

in places frequented by dogs and cats How a knowledge of the breeding habits of these insects is capable of being utilized in combating them is illustrated by the well known method of destroying mosquito larvae in water by the application of kerosine oil or Paris Green On such knowledge also are based the principles of sanitation which enjoin the effective disposal of manure and carcases in order to prevent the breeding of houseflies and bluebottles respectively In the case of horseflies again one realizes that organized campaigns directed to destroying their egg clusters are likely to prove of very appreciable value in combating these pests for a single cluster may contain hundreds of eggs

The type of life history described above, however, does not apply to the members of the families to which the bed bug and the louse belong In the case of these insects the eggs hatch into young which do not differ in appearance from their parents except for their smaller size and for the fact that the genitalia are not patent Later the genitalia develop and the insects grow in size and attain the adult state Although the bed bug and the louse thus present a similarity in so far as their life history is concerned, their habits of breeding however, are entirely different While as is well known, the bed bug commonly lives in cracks and crevices of buildings and furniture, the louse, on the other hand cannot live for any great length of time if apart from its host, on which, in fact, it accomplishes its entire life cycle Combative measures against bed bugs, therefore, frequently take the form of fumigation of infested houses, while those against lice usually consist in the application directly on the body of the host, of various insecticides such as sodium fluoride in the case of birds, and of raw linseed oil or a combination of tobacco decoction and cresol in the case of mammals

Finally a very curious type of life history characterizes *Pseudolynchia maura*, the transmitter of pigeon malaria (*ante*), and certain other related flies These deposit full grown larvae which pupate shortly after extrusion, so that, in such cases the use of traps against the adult flies is calculated to yield the largest measure of success

In formulating combative measures against insects, it is useful to remember that one is reckoning with a type of enemy which, in numerical strength, is by far the most formidable in the animal kingdom, for a total of nearly 500,000 species of insects have already been described and they represent seven tenths of the known species of all kinds of animals The number of known species of horse flies alone has been estimated at more than 2 000 and that of biting lice at nearly 1 700 The power of flight and concealment possessed by most species of insects and the amazing rate at which some of them can multiply are further points in their favour Thus, a housefly may lay more than 2 000 eggs in one month's time and at a temperature of about 30°C The approximate duration of the egg, larval and pupal stage has been found to be twelve hours, six and five days respectively, so that the time required for development from the egg to the adult is less than

twelve days. It has been estimated by Hodge [1911] that " a pai of flies beginning operations in April might be the progenitors, if all were to live, of 191,010,000,000,000,000,000, flies by August. Allowing one-eighth of a cubic inch to a fly, this number would cover the earth forty-seven feet deep ".

In practice, the combative measures aganist disease-carrying flies are frequently directed to exterminating them in the adult stage, as is witnessed by the numerous forms of traps and repellents at present in use to achieve this end. For reasons indicated in the preceding paragraph, however, the application of these measures can only yield results of a very limited value, and experience has shown that it is only by striking at the source, namely, at their bre.ding media, that a reduction in their number can be effected in an appreciable manner. These media however, are not only of an extremely varied character but are scattered over such extensive areas as to demand the closest co-operation between stock-owners and the general public for their effective disposal, and it is almost needless to say that the urge for such co-operation can only originate from a realization of the magnitude of the problem and the inestimable benefits that are likely to accrue from endeavours directed to solving it on rational lines. The immediate desideratum in this connection is to assist the stock-owner in the appreciation of the fact that it is as paradoxical to wage a continuous war against insect-borne diseases without taking any notice of the vectors themselves, as it would be to embark upon a scheme of devising methods for combating incendiarism without having anything to do with the habitual incendiary.

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EXPLANATION OF PLATES

PLATE XVIII

Diagrammatic sketches to indicate the general features of some common insect vectors injurious to live stock. The first two figures are those of ticks and are included here to indicate the difference between an insect and a tick (Drawings not made to any scale)

FIG 1 A soft tick (Argasid)
FIG 2 A hard tick (Ixodid)
FIG 3 A sandfly (*Phlebotomus* sp)
FIG 4 A buffalo gnat (*Simulium* sp)
FIG 5 A stablefly (*Stomoxys* sp)
FIG 6 A maggot from wound
FIG 7 The louse fly *Pseudolynchia maura*, the vector of pigeon malaria
FIG 8 A flea (*Ctenocephalus* sp)
FIG 9 A sucking louse (*Haematopinus*)
FIG 10 A biting louse (*Trichodectes* sp)
FIG 11 The head and mouth parts of the housefly
FIG 12 The foot of the housefly
FIG 13 Mouth parts of a horsefly
FIG 14 Mouth parts of a stablefly showing worms of summer sores (see p 9) (After Hill 1918)

PLATE XIX

Life history of a horsefly (*Tabanus* sp) a common vector of surra
FIG 1 Cluster of eggs on under surface of leaf (slightly magnified)
FIG 2 Ditto, removed from leaf $\times 4\frac{1}{2}$
FIG 3 Larva $\times 4\frac{1}{2}$
FIG 4 Pupa $\times 4\frac{1}{2}$
FIG 5 Adult $\times 4\frac{1}{2}$
FIG 6 Three surra parasites with some blood corpuscles (highly magnified)

PLATE XVIII

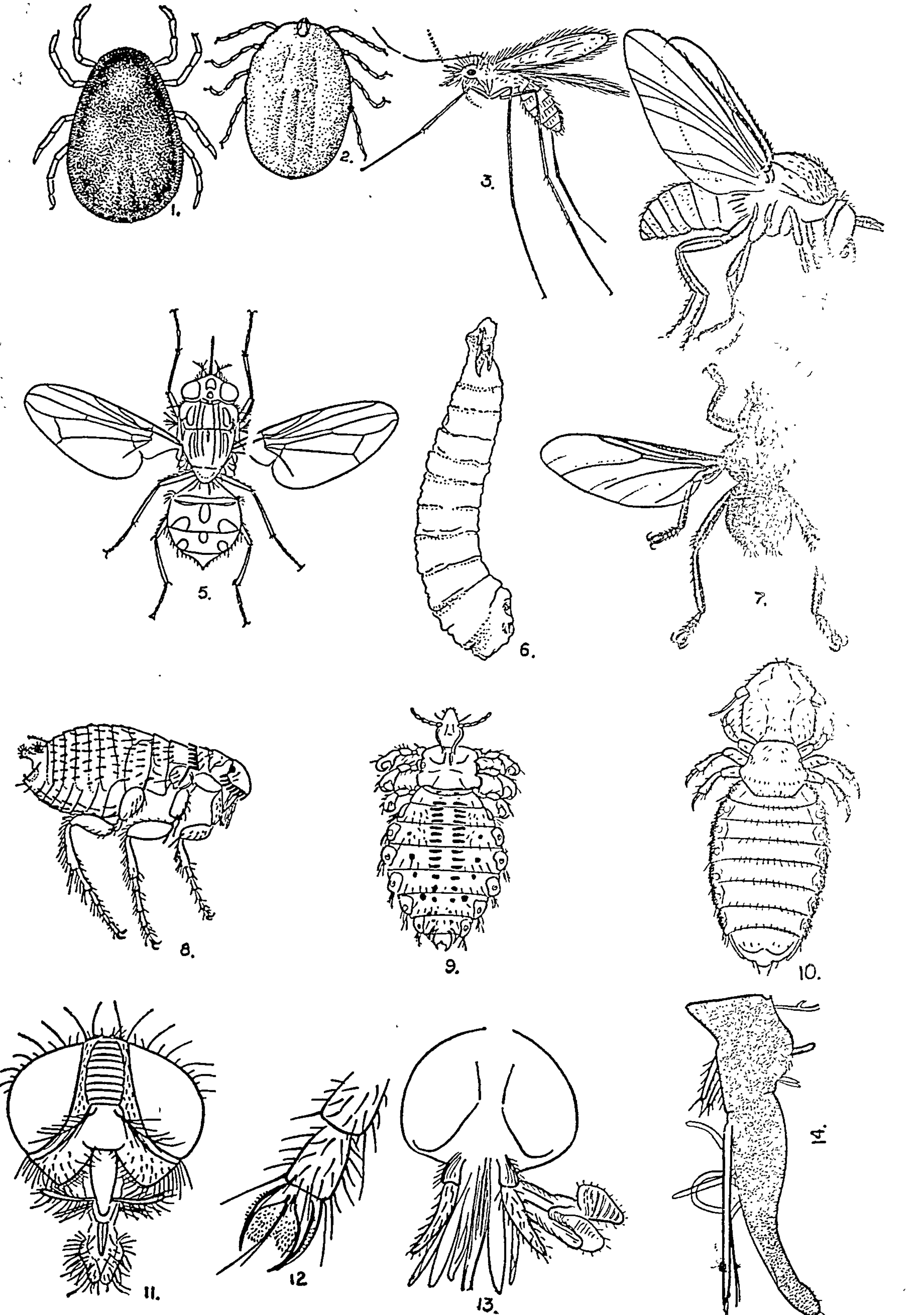
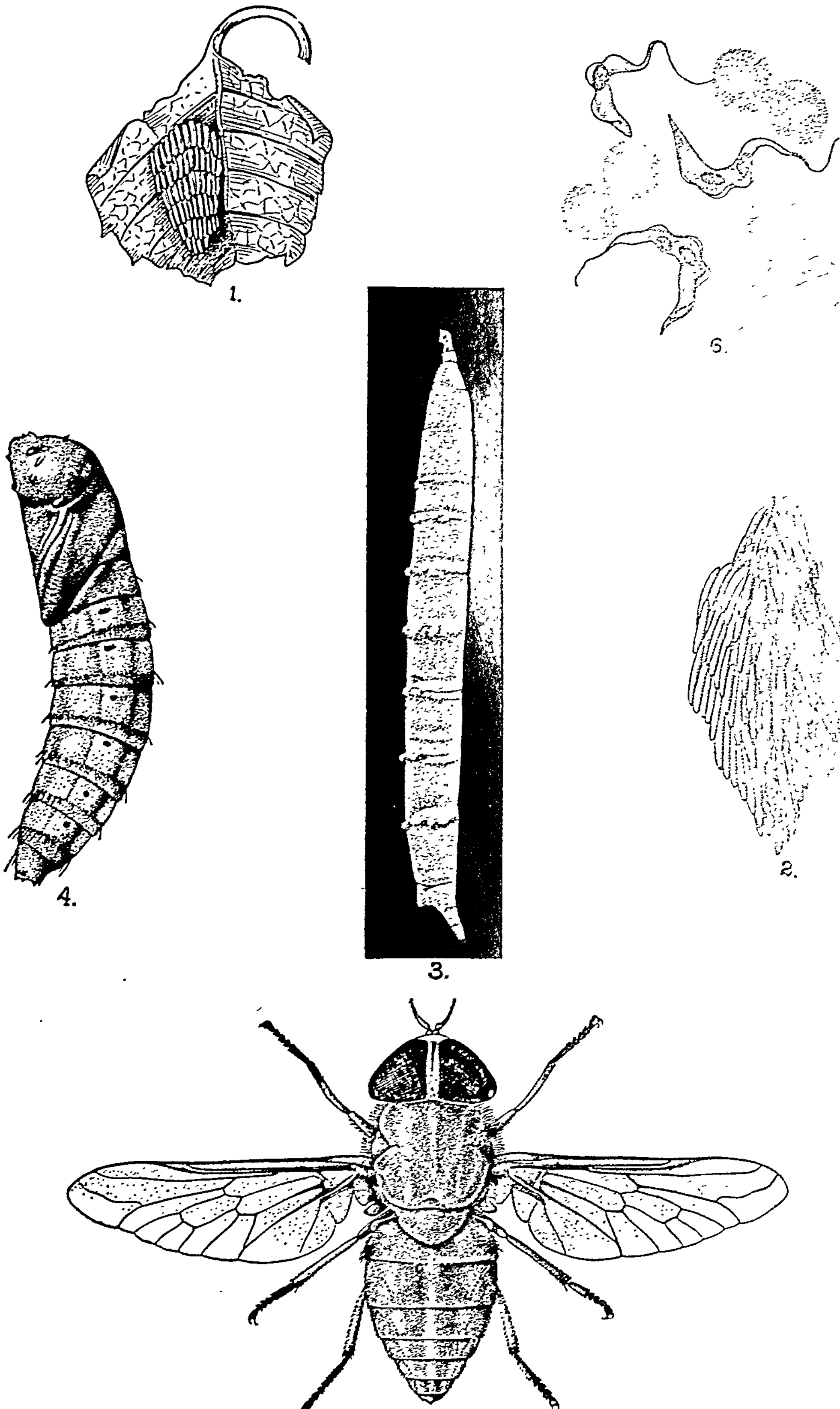


PLATE XIX

LIFE-HISTORY OF A HORSEFLY (*TABANUS* SP.)



IMPROVED PUSA OATS FOR FODDER PRODUCTION

BY

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The problem of providing suitable fodder and forage to the cattle population of India is as important as it is intricate. It is one of the main limiting factors in all schemes of cattle improvement. Good pastures are not readily available in this country and intensive methods of cultivating fodder crops are the exception. The demand for larger fodder production from urban as well as rural areas is on the increase and its importance cannot be over-emphasized.

The introduction of higher yielding varieties of food crops such as wheat, barley, rice, etc., has resulted in a proportionate increase in the available dry fodder but much remains to be done in evolving suitable crops mainly for the cattle. The agricultural departments all over India have this problem before them and interesting and useful investigations are in progress in improving crops like sorghum, maize, etc., by selection or hybridization, as well as in the introduction and acclimatization of lucerne, berseem, elephant grass, guinea grass and other grasses.

Oats may be considered a good fodder crop for horses and cattle because of their high nutritive value as well as the adaptability of the crop to a wide range of soil and climatic conditions. Oats can be fed to cattle in almost all stages of the plant's growth. In the young or green condition it yields profuse and first class green fodder. The dry straw (or hay) is readily eaten by animals. The seed serves as a valuable and important ration, largely used in dairy farms and military cantonments as one of the chief constituents of the concentrates recommended for animals. The value of oats as a fodder crop, however, is not yet sufficiently widely recognized in this country, and the purpose of this paper is to invite attention of the people concerned to the value of this important crop.

Selection, acclimatization and hybridization have all received their due share of attention with this important crop at Pusa [Shaw and Bose, 1933] and a number of valuable types and hybrids have been secured as a result of these studies. The yield of grain of these improved oats usually averages from 1500 lbs. to 2500 lbs. per acre and that of straw is one and a half to twice the weight of grain obtained. A large number of European and American oats have been tried at Pusa but even the earliest spring oats amongst them proved to be too late for Indian climates. Many of them produced excellent green fodder, in considerable quantities, but they invariably failed to set a normal amount of seed. The final quality and yielding capacity of any strain is an effect largely attributable to its inherent characters as well as to the manner in which it can accommodate itself to the soil and climatic

conditions under which it is grown It was useless, therefore, to continue the work of acclimatizing exotic oats and hybridization was resorted to Some of these hybrids so produced, not only combine high yielding power of grain with ample strong straw, but possess the added merit of maturing with less water than most of the exotic varieties—a fact which is of great advantage in a country where water supply is the principal limiting factor in crop production

To obtain the highest possible return from every acre of land is the aim of every cultivator and this can be achieved by growing good and reliable seed The superiority of pedigree seed will manifest itself on whatever class of land it is grown and Pusa oats claim this property There can be no better testimony to the worth of Pusa oats than that during the short space of less than a decade thousands of maunds of Pusa oats are now being grown in India and that the insistant demand for these oats far exceeds the supply Even the small local ryot is starting to cultivate Pusa oats for his cattle because of the attractive and valuable properties of the crop

The main strains which are distributed on a large scale at present are —

B S 1—Early maturing type evolved from Bihar oats by selection Plants semi erect in the early stage of growth, with moderate tillering capacity and weak straw Leave long and fairly narrow with a few marginal hairs Leaf sheath deep purple at the base Panicle equilateral, more or less erect, yellowish green Spikelets with thin awns and many short hairs on the callus, and *sterilis*—type of base Grains dirty yellow with a greyish tinge on the tips of the glumes High yielding, drought and smut resistant Ideal for tracts with low rainfall Bushel weight thirty five lbs

B S 2—Another selection from Bihar oats resembling B S 1 in all morphological characters but maturing about a fortnight later and rather more susceptible to smut

Hybrid C—An early maturing oat obtained by hybridising B S 2 with Scotch potato oats Plants spreading in the early stages of growth and having profuse tillering capacity and strong straw Leaves long and broad with a few marginal hairs Leaf sheath light purple at the base Panicle, equilateral, more or less erect somewhat bluish green Spikelets with thick awns and few short hairs on the callus and *sativa* type of base Grains, yellowish white, very plump High yielding and profuse-straw producing oat Very suitable for tracts with high rain fall or irrigated conditions Smut resistant Bushel weight thirty nine lbs

Hybrid I—Medium in maturity, obtained by hybridising B S 4 with Scotch potato oats Plants spreading in the early stages of growth and having profuse tillering capacity and strong straw Leaves long and broad with numerous marginal hairs Leaf sheath light purple at the base Panicle, equilateral, more or less erect, somewhat dull bluish green Spikelets with thin awns and many short hairs on the callus, and *sterilis*—type of base Grains, bright yellow in colour,

very plump. High-yielding and profuse-straw-producing oat. Smut resistant. Bushel-weight thirty-six lbs.

Hybrids C and J shatter their grain a little if they are left too long in the field after maturity.

A large number of other hybrids having some well-known exotic oats such as the Orion, Abundance, Iowa, Kinwada, etc., as one of their parents, are in the experimental stage and will soon be released for distribution.

B. S. 1 and B. S. 2 have now stood the test of time and have maintained their reputation for high yields, early maturity and drought resistance. The following table shows the average yields of these two selections at Pusa [Shaw and Bose, 1933].

TABLE I

Average yields of B. S. 1 and B. S. 2 oats at the Botanical Section, Pusa, during the period 1929-33

Type	Average yields of grain in lbs. per acre					Average of five years in lbs. per acre
	1929	1930	1931	1932	1933	
B. S. 1 . . .	2,378	2,322	1,871	2,370	2,446	2,277·4 ±62·47
B. S. 2 . . .	2,878	1,870	1,960	2,617	1,815	2,228·0 ±131·09

The superiority of these oats over the previously cultivated varieties has led the Pusa authorities to reject the latter and to adopt the former as the standard oats on the Pusa Farm. Large areas are also being put under B. S. 1 oats at Karnal and many other Provincial Farms. Some of the local Bihar planters nowadays cultivate this strain on a large scale.

A number of yield trials have also been conducted. Eleven hybrids with Scotch potato oats were tried against B. S. 1 and B. S. 2 simultaneously at Pusa and Karnal for three consecutive years [Bose, 1935] and the average yields obtained in these two localities are presented below :—

TABLE II

Average yield of grain in Pusa oats in lbs per acre, during the triennial period 1931 32 to 1933 34

Locality	Hybrids											B S 1	B S 2
	A	B	C	D	E	F	G	H	I	J	K		
Pusa . .	1,548·6	1,290·5	2,105·3	1,759·0	1,922·0	1,912·2	2,040·2	1,518·2	1,853·1	2,096·7	1,597·9	2,263·4	2,221·4
Karnal .	1,758·8	1,255·7	1,935·7	1,813·9	1,769·0	1,650·1	1,993·7	1,585·1	1,619·7	2,031·5	1,813·9	1,905·3	2,083·6

It will be evident from the above table that the five high yielders in the experiment were B. S. 2, B. S. 1, and Hybrids C, J and G in the order given, though the yields of B. S. 1 and Hybrids C, G and J were not found to be statistically different from each other. In these three hybrids, however, the high-yielding capacity of the Pusa parents have been combined with the plump grain, profuse straw and other good qualities of the Scotch Potato oats.

An idea of the production of straw in the hybrids and B. S. 1 and 2, mentioned above, may be formed from Table III where the comparative yields of dry straw, as obtained at Pusa in 1934, are tabulated.

In order to study the differences in the yields of green fodder, grain and of straw in two Pusa selections, seven Pusa hybrids and an exotic oat, *viz.*, Iowa, 103, a yield trial was conducted at the Botanical Sub-station,* Pusa during 1936-37. The experiment was laid out in randomized blocks, with five replications. The size of each sub-plot was one-fortieth of an acre, from half of which green oats taken at the right stage were cut, the other half being allowed to mature to seed. The results obtained are presented in Table IV.

*Financed by the Imperial Council of Agricultural Research.

TABLE III

Comparative yields of straw in oats at Pusa in 1934

(Barah I)

—	Yields of dry straw in lbs												
	Hybrids											Types	
	A	B	C	D	E	F	G	H	I	J	K	B S 1	B S 2
Yield per acre .	2,903 71	3,969 19	3 107 57	4 243 62	4 072 25	2 732 08	4,067 63	2 590 08	2 803 52	3,854 19	3 139 99	3 061 01	3,709 30
Percentage yield taking B S. 1 as control	94 77	129 54	101 42	138 50	152 49	89 17	132 76	84 53	91 50	125 79	102 48	100 00	123 10

TABLE

Average yields of green fodder, grain and straw from Pusa oats 1936-37

(Plots 1/80th acre in size)

Yield of	Per	Mean yields in lbs.										General Mean	Standard error of mean difference
		A B. S. 1	B B. S. 2	C Hy. C	D Hy. VII-54	E Hy. VII-144	F Hy. VII-265	G Hy. G	H Hy. VII-578	I Iowa 103	J Hy. J		
Green fodder	Plot	154	132	161	132	138	136	148	153	155	155	146	10·3
	As a percentage of the general mean	105	90	110	90	95	93	101	105	106	106	100·0	7·1
Grain	*Plot*	23·38	20·24	16·70	15·06	12·94	16·06	17·08	18·36	19·52	23·34	18·27	1·11
	As a percentage of the general mean	128·0	110·8	91·4	82·4	70·8	87·0	93·5	100·5	106·8	127·8	100·0	6·1
Straw	Plot	33·41	40·16	41·30	34·74	38·68	35·54	36·14	40·04	50·28	41·66	39·20	2·42
	As a percentage of the general mean	85·3	102·4	105·4	88·6	98·7	90·7	92·2	102·1	128·3	106·3	100·0	6·17

A study of these figures shows that the yield of green fodder is much the same in all types, while in so far as grain yields are concerned those of B S 1 Hybrid I and B S 2 are statistically better than those of the rest which among themselves show considerable differences The highest yield of straws was obtained by Iowa 103 the lowest from B S 1 This experiment, however, is not entirely conclusive as the unusually long drought during the growth period of this crop in the cold weather of 1936 37 appears to have been reflected in decreased crop yields especially in the matter of the green fodder It is proposed to repeat the experiment for further observations

The number of strains of oats at Pusa, now on the distribution list or in the course of trial is quite large It is believed that enough material is thus available to meet the needs of the many different soil and climatic conditions under which the crop might be grown It is therefore suggested that wider trials of Pusa oats might be with advantage undertaken by those interested in the improvement of Indian live stock

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thoroughly with water The solution is made up to volume and the colour compared with standard dichroma e solution The ether is evaporated off under reduced pressure and the residue is taken up in light petroleum The caroten is partitioned off from xanthophyll with 90 per cent aqueous methyl alcohol The colour comparison is made after suitable dilution and the carotene content determined with the help of the curves given by Ferguson [1935]

In the method adopted by us the mango pulp (5 to 10 grms) is dehydrated by grinding with sufficient quantity of anhydrous magnesium sulphate in a glass mortar and pestle to a fine dry powder This is extracted three or four times with petroleum ether and the carotene xanthophyll partition made in the usual way The methods of colour comparison and calculation are similar to those employed in Ferguson s method

TABLE I

Comparison of Ferguson and Bishop s method and that adopted by the authors

Name	Ferguson and B shop		Method adopted	
	Carotene mg per kg	Xanthophyll mg per kg	Carotene mg per kg	Xanthophyll mg per kg
Badami	134	40	140	10
Malgoba	6	4	12	Negl gible

The latter method has advantages over Ferguson s method in that the petroleum ether easily extracts the pigments in three or four extractions Losses due to digestion at a high temperature and from the change of solvent—from ethyl to petroleum ether—are avoided The possibility of interference due to saponifiable matter coming down in the petroleum ether extract was examined and found to be negligible The quantity of xanthophyll in the extract was small

Vitamin C was estimated by titration with Tillman's reagent and iodine solution About fifty grammes of mango pulp were triturated in a glass mortar and pestle with enough of acetic acid to make up 5 per cent in the final volume The pulp was put in a muslin cloth and exhausted with water The extract was made up to volume and immediately titrated The iodine solution and the Tillman s reagent were standardised against International Standard ascorbic acid At no stage in the process was any metal allowed to come into contact with the pulp

Four kinds of mangoes were available for the experiments. 1. Mangoes re-
-ed from Vizagapatam representing Northern Circars and sent by rail. 2. Lo-
varieties grown round about Bangalore. 3. Imported varieties grown in or-
-rds in Bangalore. 4. Mangoes grown in the Cauvery valley near Seringapatam.
l the samples could not be obtained in the best condition, especially those from
-stant places. The results given below are, however, of considerable use and in-
-rest to growers and consumers.

TABLE II

Carotene and vitamin C content of various species of mangoes

-ource	Name	Carotene in mg. per kg.		Vitamin C in mg. per kg.		Remarks
		Dichromate colour comparison	Lovibond Tintometer	Iodine titration	Tillman's reagent	
From Vizagapatam	Banganapalli 1	5·6	6·4	0·097	0·015	Plucked too early
	Banganapalli 2	11·8	19·0	0·141	0·075	Fully ripe. Normal
	Peddarasam .	12·2	12·8	0·298	0·185	Did not develop full colour, flavour or sweetness
	Neelam . .	10·4	10·0	0·352	0·224	Ditto
	Himayudin Phasand . .	5·8	4·0	0·233	0·116	Ditto
	Suvarnarekha .	3·4	4·0	0·071	0·025	Ditto
	Nalla Andrews .	4·2	4·4	0·474	0·491	Ditto
	Jehangir . .	2·6	2·8	0·266	0·065	Ditto
Local	Badami . 1	140	..	0.740	0·456	Fully ripe. Normal.
	Badami . 2	80	108	..	..	Mature fruit. Ripened in the incubator at 37°C.
	Raspuri . 1	13·8	18·5	0·018	0·087	Fully ripe. Normal
	Raspuri . 2	15·2	22·0	0·139	0·112	Ditto
	Raspuri . 3	19·8	..	..	0·044	Ditto
	Malgova . .	12·0	..	0·191	0·157	Ditto
	Hamlet . .	5·4	4·8	0·559	0·515	Highly acid
	Sour Stone variety	11·4	13·5	0·760	0·830	Ditto

TABLE II—*contd*

Source	Name	Carotene in mg per kg		Vitamin C in mg per kg		Remarks
		Dichro mate colour compa rison	Lovi bond Tinto meter	Iodine titra tion	Till man's reagent	
Seringapatam	Badami	60	63	0 640	0 652	Better than the local variety in taste
	Amini	7 6	10 5	0 150	0 056	Very sweet
	Guava	6 0	0	0 567	0 593	Ditto Good flavour
	Malagusunde amini	6 0	..2	0 117	0 141	Ditto
	Velur Gola	50		0 191	0 145	Resembles Neelam
	Bather Gunde 1	11	4 5	0 125	0 093	Fibrous Poor quality
	Bather Gunde 2	27 6	..5	0 585	0 402	Rich yellow colour
	Raspuri seedling	28	33	0 182	0 112	Fibrous Poor quality
Imported varieties grown in Bangalore	Langra	30	33	0 158	0 112	Immature Poor sample
	Bombay 1	8 4	10	0 104	0 059	Ditto
	Bombay 2	44 8	46	0 186	0 127	Ditto
	Gopal Bhog	8 8	9 3	0 416	0 366	Poor sample
	Kutcha Mitha	15	18 4	0 064	0 008	Ditto
	Krotahal chota	23	28	0 105	0 035	Ditto
	Sabza Malda	21 4	24	0 641	0 619	Ditto
	Alfonso	34	34 5	0 766	0 833	From a 2 year old graft Poor sample
	Fazli Bhog	14 8	15 3	0 159	0 152	Poor sample
	Palace Orchard	18	20 8	0 186	0 132	Ditto

NOTE—Iodine titration for vitamin C has generally given a higher value due possibly to other ingredients present in the juice that might have reacted with the iodine While the same factor does not apply in the case of carotene determination by the Tintometer or dichromate solution, the chances of error due to the use of tinted glasses and other aspects of the technique followed in such determinations should not be under estimated

DISCUSSION

Vitamin A and C content increases during ripening after plucking Any form of injury or damage that retards ripening decreases the vitamin value The change

in colour of the pulp from pale yellow to rich reddish yellow is a fair indication of the increase in carotene content. The nature of the carotene, whether alpha, beta, or gamma, could not be determined for want of a suitable chromatographic technique. However, according to Yamamoto *et. al.* [1932], the carotene should consist mostly of alpha and beta varieties. The vitamin content depends on the variety and other factors. Crawford and Perry [1933] found the vitamin A content of 'Alfonso' to be approximately equal to that of good butter and that of 'Cowasji Patel' and 'Shendrya' to be about half. The vitamin C content of 'Alfonso' was about twice as high as that of lemon juice; the other two were less active. Guha and Chakravarty [1933] observed substantial variations in the vitamin content of the different varieties of the Indian mango. De [1937], using a spectrographic method, has determined the carotene content of about a dozen varieties of mango fruit.

The results of the present analysis (Table II) show that the vitamin content of mangoes varies very much from one variety to another. It should also be noticed that the time of plucking and stage of ripening influence the vitamin content to a very great extent and these factors, probably, are responsible for the very high variation in the values obtained for Badami 1, 2, and Badami from Seringapatam; Bombay 1 and 2; Bather Gunde 1 and 2. It is possible, however, that normal, fully-ripe fruit of each variety, grown in the same locality, can be characterised by a definite range within which the vitamin content may vary; and for this purpose, a thorough investigation of the influence of manuring, soil-fertility, and climatic conditions as also the time of plucking and stage of ripening on the vitamin content of the fruit is essential.

Fruits obtained from seeds (not grafted) are generally inferior and fibrous. They are not fit for table use, but are well suited for extraction of juice and drying in thin sheets artificially. The imported varieties appear to have suffered in quality generally. Banganapalli and Jehangir are the two most popular varieties of the Northern Circars and they are sold at a high price. They are very delicious and have a good flavour with firm pulp and are not fibrous. But they are very poor in vitamin content. Certain other varieties (*e.g.*, Nalla Andrews, Hamlet, Sour Stone), though poor in carotene content, are very rich in vitamin C; but on account of their high acidity, low sugar content, and fibrous pulp, they are not popular. However, they are eminently suited for pickle preparations. Their vitamin C content is very high—sometimes double that of lemons. Preserved in vinegar or lime juice, they should be ideal material for storing up vitamin C, and the industrial aspect of the preservation of such varieties is worth studying.

Among the local varieties, Badami is undoubtedly the best on account of its high carotene and ascorbic acid content. It is said to be the 'Alfonso' variety imported and grown in the Mysore State.

SUMMARY

About thirty varieties of mangoes were analysed for their carotene and ascorbic acid content using a simple technique for the estimation of carotene. There are very high variations in the vitamin content of the different species and even in the same variety they differ from one sample to another.

The influence of the time of plucking stage of ripening as also soil fertility and climatic conditions on the vitamin content of the fruit is worth investigation.

Badami is the best among the varieties analysed.

Our best thanks are due to Dr L S Doraiswamy of the Mysore Horticultural Department for kindly arranging to provide us with most of the samples used in this investigation.

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NOTE ON EFFECT OF STRIPPING OF DRY CANE LEAVES FOR PREVENTION OF DAMAGE BY PYRILLA ATTACK (UNITED PROVINCES—1935-36)

BY

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PRIOR to 1935 stripping of the dry leaves and removal to a distance from the field as a method of reduction of Pyrilla attack was conducted as opportunity arose on the Cawnpore Research Farm. The examination of this method was arranged for at Muzaffarnagar Research Station as a piece of the entomological investigations. The time available for this work at Muzaffarnagar was limited owing to the large amount of other routine observations for which the Assistant Research Entomologist was responsible. The experiment also could be conducted only on such areas as were not under cultural, manurial or irrigation experiments.

In the seasons 1935-36, 1936-37 Pyrilla attack was negligible. In 1937-38 Pyrilla infestation was very heavy. The limited area upon which stripping could be carried out involved the certainty of re-infection from the adjacent unstripped cane. Samples of cane were taken by a statistically valid method of randomisation, crushed and analysed for brix, sucrose per cent of juice and purity per cent on the dates shown in the appended table. Effects by way of increase or decrease percentage brix, sucrose and purity of the juice from stripped over unstripped samples are shown beneath each variety for each season from the Muzaffarnagar farm.

In September 1937 the sugarcane on the Bulandshahr Government farm was found to have developed a very heavy attack of Pyrilla and the dry leaves from the whole of the cane on the farm were stripped and heaped at a distance. One stripping only was given.

EXAMINATION OF THE RESULTS

Muzaffarnagar farm

1935-36.—Notwithstanding the fact that there was no serious Pyrilla attack on the Muzaffarnagar farm in this year, the figures for brix, sucrose and purity are appreciably higher in the stripped than the unstripped cane.

1936-37.—Brix was higher in the unstripped cane but sucrose and purity were higher on the stripped cane.

1937-38.—In all cases brix, sucrose and purity were appreciably higher in the stripped than in the unstripped samples. In the case of Co. 508 samples from

unstripped fields of the farm in which no reduction of the pest could have taken place from the stripping experiment, the effect in favour of stripping was much more marked than in the case of the samples from stripped and unstripped portions of the same field where the disturbance caused by stripping is likely to have resulted in redistribution of the Pyrilla population between the stripped and unstripped portions thus masking the beneficial effect

Bulandshahr farm

The whole of the cane on the Bulandshahr farm was stripped No valid comparison is possible with cultivator's cane in the neighbourhood Here it was not found necessary on this occasion to strip more than once as after the first stripping the Pyrilla attack became negligible The results must be judged by the average standard of cane of the area in a normal year The figures for November, January and February indicate that in brix, sucrose and purity the resultant crop was up to normal standard

The data presented is incomplete All available information will be included in the next progress report of the United Provinces Sugarcane Research Scheme. Earlier and later strippings have been made with equally good results It would appear that even in the absence of severe Pyrilla attack stripping of cane during the later part of the monsoon results in a sufficient increase in sucrose content to render the practice economic

Preliminary figures showing the Brix, sucrose per cent juice and purity from cane subjected to stripping of dry leaves on August or September on Muzaffarnagar and Bulandshahr Government farms

Year and place	Variety	Treatment	Juice analysis Per cent Brix	Juice analysis Per cent Sucrose	Juice analysis Per cent Purity	Juice analysis Per cent Brix	Juice analysis Per cent Sucrose	Juice analysis Per cent Purity	Juice analysis Per cent Brix	Juice analysis Per cent Sucrose	Juice analysis Per cent Purity	Remarks
			6-12-1935			*24-2-1936*						
1935-36	Co 370	(a) Stripped September.	15·82	12·44	73·45	18·30	15·80	86·10				Pyrilla attack not serious this year.
Muzaffarnagar	Co 370	(b) Unstripped	14·87	11·28	75·67	18·12	15·58	85·90				
		Increase (a) over (b)	0·95	1·16	2·78	0·27	0·31	0·50				
	Co 313	(a) Stripped September				19·89	17·81	89·55				
	Co 313	(b) Unstripped				19·59	17·30	88·35				
		Increase (a) over (b)				0·30	0·51	1·20				
						27-2-1937			*18-3-1937*			
1936-37	Co 312	(a) Stripped September				19·52	17·42	89·25	20·19	18·14	89·75	Pyrilla attack not serious again this year.
Muzaffarnagar	Co 312	(b) Unstripped				19·72	16·69	84·55	20·49	18·02	87·80	
		Increase (a) over (b)				−0·20	0·73	4·70	−0·30	0·16	1·95	
			21-12-1937			*25-2-1938*						
1937-38	Co. 312	(a) Stripped September.	15·08	11·44	75·80	17·09	14·19	83·05				Pyrilla attack severe.
Muzaffarnagar	Co 312	(b) Unstripped	14·08	10·40	73·80	15·69	12·35	78·75				
		Increase (a) over (b)	1·00	1·04	2·00	1·40	1·04	4·30				
	Co 508	(a) Stripped September	17·39	14·65	84·25	18·63	15·36	82·50				Same field.
	Co 508	(b) Unstripped	15·33	11·58	75·65	17·67	14·21	80·35				Same field.
	Co 508	(c) Unstripped				16·23	12·52	76·76				Average of unstripped fields of farm.
		Increase (a) over (b)	2·06	3·07	8·60	0·96	1·15	2·15				
		Increase (a) over (c)				2·40	2·84	5·74				
	Co 560	(a) Stripped September	16·29	12·57	77·25	18·40	15·59	84·75				
	Co 560	(b) Unstripped	13·59	9·24	68·00	16·00	12·10	75·65				
		Increase (a) over (b)	2·70	3·33	9·25	2·40	3·49	9·10				
			24-11-1937			*8-1-1938*			*5-3-1938*			
1937-38 Bulandshahr	Co S 19	Stripped September	16·52	11·96	77·05	17·96	14·23	84·20	19·33	16·06	83·15	The whole area under sugarcane at Government Bulandshahr farm was stripped from 7th to 11th, September as it was very badly infested with Pyrilla. The pest attack became negligible after one stripping.
	Co S 60	,,	16·02	12·54	78·30	18·24	14·74	80·80	20·83	17·94	86·20	
	Co 300	,,	16·62	13·79	83·00	18·24	15·05	82·25	20·06	18·75	89·35	
	Co 312	,,	13·22	9·71	73·75	17·66	14·38	81·40	18·96	15·82	83·40	
	Co 313	,,	16·22	12·98	80·10	18·14	14·88	82·02	21·26	18·32	86·20	
	Co 331	,,	15·64	11·61	74·20	17·64	14·26	80·78	20·86	18·27	87·70	
	Co 370	,,	15·22	10·88	71·50	18·06	14·67	81·20	19·56	17·54	89·65	
	Co 385	,,	16·05	12·56	78·30	18·66	15·77	84·50	21·29	19·09	89·70	
	Co 508	,,	16·58	12·93	77·95	19·96	16·99	85·12	19·79	16·08	81·30	

STUDIES ON THE LOSS OF FAT DURING BUTTER MAKING AND PREVENTION OF THIS LOSS

BY

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THE profits in the manufacture of butter on a commercial scale depend to a large measure upon the maximum recovery of butterfat from the cream during the process of churning Some fat is always carried away in the buttermilk and the amount thus lost largely depends on the conditions of working The present investigation was therefore undertaken with a view to so modifying the process as to reduce the fat losses in buttermilk to a minimum and thus making the manufacture of butter more economical In the course of the experiment, therefore citric acid and sodium citrate were added to cream, and their effect on the flavour aroma, grain structure and the keeping quality of the resulting butter was studied Some of the previous workers have employed citric acid and sodium citrate without reaching any definite conclusions as to their usefulness Thus, Hunziker [1927] states that the addition of citric acid in cream ripening may be of some value in the production of flavour and aroma in butterfat, but that our present knowledge is too limited to justify its recommendation for general practice Templeton and Sommers [1935] used citric acid and sodium citrate in buttermaking and noticed that citric acid tended to lower the fat losses in the buttermilk Greenbank and Holm [1934] and Lea [1936] have recommended sodium citrate and citric acid as powerful anti oxidants This observation has, however, been contradicted by Olcott [1934]

In the present work a critical study is therefore made of the various effects, such as on aroma production, prevention of fat losses in buttermilk, etc, which citric acid and sodium citrate are supposed to exercise

I EXPERIMENTAL

(i) *Preparation of cream*

The cream was taken fresh from the separator and standardised to the desired fat percentage Flash pasteurised at 160°-165°F (71 11° to 73 88°C) and then cooled rapidly to 70°F (21 1°C) After pasteurisation starter was added to the cream at the rate of 3 lbs of starter for every 100 lbs of cream Before mixing with the cream the starter was strained through a fine muslin The acidity of the starter was between 0 7 and 0 8 per cent (lactic acid) The cream was then divided into three lots of equal weight Two of these samples were treated with

c. c. of 0·2 per cent of well-boiled and filtered sodium citrate and citric acid tions respectively and the samples thoroughly stirred. The third sample red as control. In order to control the acidity in the three samples, *viz.*, un-ated cream, sodium citrate treated and citric acid treated, it was necessary to p them for ten hours, first two at about 72°F. and the third at 68°F., for the elopment of the required acidity, *viz.*, 0·25-0·30 per cent lactic acid.

(ii) Temperature of ripening

After the pasteurisation of the cream as explained above, the cream was ed for fourteen hours at 48° to 50°F. Observations were made with a view to idy the influence of holding cream at high temperatures ranging from 48° to 64°F. the loss of fat in buttermilk. The concentration of fat in cream was thirty r cent and it was churned at 54°F. The results are illustrated in Figs. 1 and 2. cording to Toens and Hammer [1925] lower temperatures (68° to 72°F.) provide tisfactory conditions for starters. This range of temperature has the added lvantage of being unfavourable to the growth of organisms which resist pasteuri-ition. At higher temperatures the acid development increases and this generally ccurs at the cost of the desired flavour and aroma. The high acid content of ream precipitates the casein which locks up fat in the curd and some of it passes 1 the buttermilk.

iii) Effect of citric acid and sodium citrate on the flavour and aroma of butter

The butter samples treated with citric acid and sodium citrate had always a uperior aroma than the control (untreated samples). Table I below shows scores on butter flavour and aroma.

TABLE I

Average score of thirty samples of butter made with the addition of citric acid and sodium citrate

	Initial	10 days	20 days	30 days	60 days
Control . . .	+++	+++	+	+	--
Citric acid . . .	+++	+++	++	+	-
Sodium citrate . .	+++	+++	+++	++	+

Further, samples treated with citric acid produced better aroma than those treated with sodium citrate. This shows that citric acid and sodium citrate favour the development of good flavour and aroma. According to Hunziker [1927] these substances are utilized by the flavour producing organisms during cream ripening, for the purpose of developing volatile acids upon the presence of which depends the flavour and aroma characteristic of good butter. Hence if sufficient amount is not present it interferes with the development of good odour.

(iv) *Manufacture of butter*

Butter was made in hand churns, and as far as possible, under identical conditions Three churnings were prepared daily, one treated with sodium citrate the other with citric acid and the third was control Butterfat determinations were made by Gerber's method both on the cream and buttermilk The following optimum conditions o manufacture were observed

(a) *Temperature* —For each churning ten lbs of cream was used varying in fat percentage from twenty to fifty The atmospheric temperatures during the experimental period varied from 72° to 74°F The cream was churned between 54° to 56°F, this being the optimum temperature for churning under the experimental conditions With a higher temperature there was a rapid aggregation of fat globules and with a very high temperature there was a further division of large globules which resulted in a greater loss of fat in the buttermilk On the other hand when too low a temperature was used in churning the period of agitation was considerably prolonged as under this condition the fat globules got hard and did not cohere The low temperature also affected the shape of the fat globules The effect of low temperature was noticeable to a more marked degree on cream of low fat per cent i e below thirty per cent than on cream of high fat per cent

(b) *Richness and consistency of cream* —When cream with a high (35 50 per cent) or too low (below 30 per cent) a fat per cent was churned greater loss of fat occurred in the buttermilk as shown in Fig 2

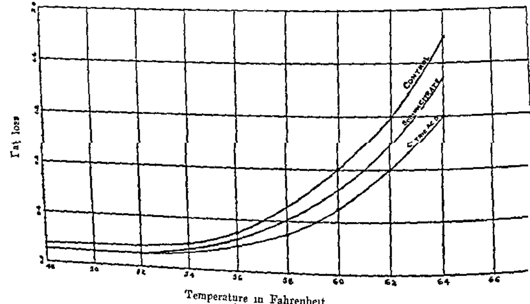
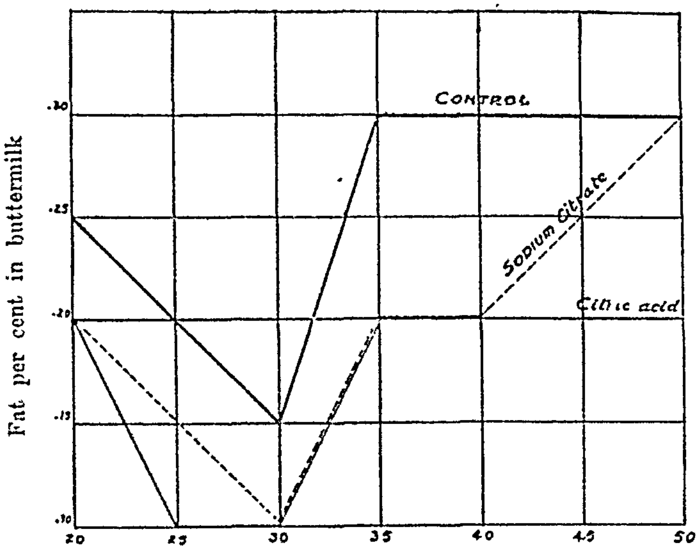


Fig 1



Fat per cent in cream

FIG. 2

The best results were obtained when cream with 30 per cent fat was churned. From the economic stand point it is not advisable therefore to churn too thin or too thick a cream. In the former case there was less agitation of cream due to a large portion of milk serum being present which acted as a buffer, and prolonged the churning period. Rich cream generally churns easily when agitated, but too often the cream gathers in the form of thick plastic mass and becomes viscous. This viscous cream adheres to the walls of the churn which makes it difficult to agitate, thereby prolonging the churning period. When the cream churns with difficulty butter granules are exceedingly slow in gathering and this results in a greater loss of fat in the butter-milk (Fig. 2). This loss of fat is further increased by certain amount of unchurned cream adhering to the walls of the churn. When however cream with fat content of thirty to thirty-five per cent is churned there is a maximum recoverability of butterfat from the buttermilk and the churning process is completed in a comparatively short period.

(c) *Speed of churning.*—To effect maximum agitation of cream it is important to maintain a uniform speed of the churn. This also results in uniform sized grains. As soon as the 'breaking' stage is reached

the agitation should be carried out with great care till the grains attain a fair size The 'breaking water' should be added in two stages Half the quantity should be added first and the agitation continued till the grains attain the size of pin heads and then the remaining quantity of 'breaking water' added and churned till the desired size of grain is obtained This method of adding 'breaking water' allows sufficient time for the grains to attain their maximum size If the butter granules are very small, due to under churning an excessive loss of fat in buttermilk occurs However complete agitation of the cream is not possible since some of the fat is in such a stable emulsion that it escapes unbroken during churning

Other things being equal, the samples treated with citric acid and sodium citrate showed better separation of fat from the cream than the control samples (Figs 1 and 2) Citric acid was superior to sodium citrate in this respect The loss of fat in the buttermilk was reduced to a minimum when the fat content of the cream was maintained at 30 per cent At this concentration sodium citrate compared very favourably with citric acid which registered the lowest fat loss in the buttermilk The cream treated with citric acid took slightly less time to break than the other two samples, acidity and other conditions remaining the same After drawing the butter milk a sufficient number of washings was given to the butters treated differently to effect the removal of buttermilk Then the butter was removed on the butter worker and worked once, three per cent salt was sprinkled over the butter which was then worked three times The moisture content of this butter varied from 13 5 to 14 per cent The butter was wrapped up in double butter paper Each butter sample was divided into three parts of half pound each and immediately transferred to the cold store maintained at 50°F Each of the samples was examined after definite intervals for flavour, aroma, and keeping quality The resulting butter from the cream treated with citric acid and sodium citrate had an agreeable flavour and aroma Though the treated cream had a pronounced aroma in the case of citric acid samples as compared to sodium citrate samples, there was very little difference in the resulting butter

(v) *Keeping quality of the butter*

Experiments on the keeping quality of the butter samples prepared by the above method showed that the butter from cream samples treated with sodium citrate had a longer induction period than those treated with citric acid or the controls The results are given in Table II

TABLE II

*Peroxide test on the butter samples stored at 50°F. after various treatments**

Name of the sample	No. of samples tested	No. of days old	$N/100$ sodium thiosulphate required for 100 g. of samples
Control	30	20	2·03
Citric acid treated	30	20	nil
Sodium citrate treated	30	20	nil
Control	30	30	9·9
Citric acid treated	30	30	7·0
Sodium citrate treated	30	30	6·28
Control	30	40	12·5
Citric acid treated	30	40	8·7
Sodium citrate treated	30	40	6·9
Control	30	60	16·2
Citric acid treated	30	60	13·1
Sodium citrate treated	30	60	9·1

*Peroxide was estimated by the method described by Wheeler [1932].

The results show that with sodium citrate the induction period after sixty days is almost doubled.

II. DISCUSSION

Addition of citric acid and sodium citrate to the cream improves the aroma, flavour, and keeping quality of the resulting butter. The loss of fat in the buttermilk can be reduced to a considerable degree by the addition of one of these compounds to the cream. This may be due to the promotion of clumping of fat globules. Van Dam and Sirks [1932] and Palmer and Anderson [1926] studied the factors influencing creaming and concluded that milk plasma primarily influences creaming. Rahn [1921] has drawn similar conclusions. It is probable that citric acid brings about the coagulation of casein contained in the cream, thus setting free the absorbed butterfat held in mechanical combination with casein, with the result that the loss of fat in buttermilk is reduced. It is found that in order to obtain the minimum loss of fat in the buttermilk the fat percentage of cream should be maintained at thirty. This also produces grains of ideal size. Another important factor which determines the loss of fat in the buttermilk is the ageing and churning temperature. The rate at which aggregation of fat occurs is primarily dependent upon the temperature. If the temperature is very low the globules do not adhere to one another and therefore churning of cream merely distorts the shape of the globules and causes no aggregation. Again if the temperature is very

high the number of larger globules produced is relatively very small and even sub division of the glolules occurs The optimum temperature under the experimental conditions was found to be 54°—56°F Butter made from cream treated with sodium citrate keeps better than that made from cream containing citric acid, the control samples being comparatively very poor in this respect

III Summary

(1) When the concentration of fat in the cream is maintained at thirty per cent a minimum amount of fat is lost in the buttermilk

(2) The optimum temperature of ageing is 48°—52°F and that of churning the cream 54°—56°F

(3) Citric acid and sodium citrate reduce the loss of fat in the buttermilk to a minimum, registering in both cases 0 1 per cent loss when cream with thirty per cent fat is churned Control samples showed a loss of 0 15 per cent fat

(4) Addition of citric acid or sodium citrate to the cream improves the flavour aroma and keeping quality of the resulting butter

Acknowledgments

I am greatly indebted to Mr Zal R Kothavalla, Imperial Dairy Expert for providing me the necessary guidance and helping me in judging the butter samples to Mr S Cox and Mr H C Verma for grading the samples of butter

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SELECTED ARTICLE

THE "HAY-BOX" METHOD OF HEATING MILK, FOR INDIGENOUS GHI-MAKING

BY

W. S. READ

(Punjab Veterinary Service)

(Reprinted from the Veterinary Bulletin No. 8 of the Civil Veterinary Department, Punjab, 1936)

The "hay-box" is a means of storing heat, and is used for cooking or keeping food hot for long periods, when fuel is scarce. It is a very ancient practice, and is used with great success by armies in the field.

Recently, experiments have been carried out in the Punjab, to ascertain whether this practice can be applied for heating milk in Indian households, to save fuel. The bulk of fuel used for heating milk at present is made from cowdung, which would have a much greater economic value if put back into the land to fertilise crops.

The series of experiments carried out at the Government Cattle Farm, Hissar, indicate that milk heating by the hay-box method not only saves fuel, but produces a large amount of *ghi* from a given quantity of milk.

There are various methods of preparing milk for *ghi* in the villages, the more common of which are as follows :—

1. The morning milk is brought to the boil and then stands all day cooling off until the unboiled evening milk is added.

2. The morning milk is simmered all day, and the evening milk is boiled and added to it.

3. The morning milk is simmered all day, and the evening milk is added to it, unboiled.

By all three methods the subsequent operations are the same, *viz.*, the "starter" (usually a piece of curd or *lassi*) is added to the milk at night, which becomes ready for churning in the morning.

The tabulated statement at the end of this article shows a comparative result of these three methods It also clearly shews the benefits of introducing the hay box into methods 2 and 3 It will be observed that method 3 A gave the best results, and that this is a combination of indigenous method 3 and the hay box Moreover it will be noticed that in each case the hay box is superior to the indigenous methods, inasmuch as it saves fuel, produces more *ghi* per pound of milk used, and makes very palatable *lassi*

It should be mentioned that the work in connection with these trials was carried out by an Indian lady using the ordinary indigenous vessels and utensils in common use An official of the farm simply did the weighing and measuring of the materials used and explained the use of the hay box to her It is therefore, quite obvious that this method of milk heating can easily be done in any Indian household

Each trial was repeated several times, to avoid any possibility of error, before the final results were tabulated

HOW TO USE THE "HAY BOX"

(*i*) As it is necessary that the morning milk should almost fill the vessel (*kaharni*) in which it is to be heated a *kaharni* of the correct size should be obtained

(*ii*) Procure a wooden box the length and breadth of which should be about twice the greatest diameter of the *kaharni*, and about ten inches more than its height If the planks of the box are not a good fit, a carpenter should take it to pieces and rebuild it so that air cannot easily pass between the planks The lid should have some small strips of wood fitted on the inside so that it fits tightly into the top of the box

(*iii*) Place dry hay or *bhusa* in the bottom of the box, and press it down firmly —but not too tightly—to a depth of about six inches

(*iv*) Bring the milk in the *kaharni* to the boil and when quite certain that it is boiling place the *kaharni* in the centre of the box on the bed of hay or *bhusa* More dry hay or *bhusa* should then be packed into the box all round the *kaharni* up to a level with the top If desired a metal or wooden cap may be placed over the top of the *kaharni*, so that it can be completely covered with the hay The box should then be put out of the way until the evening

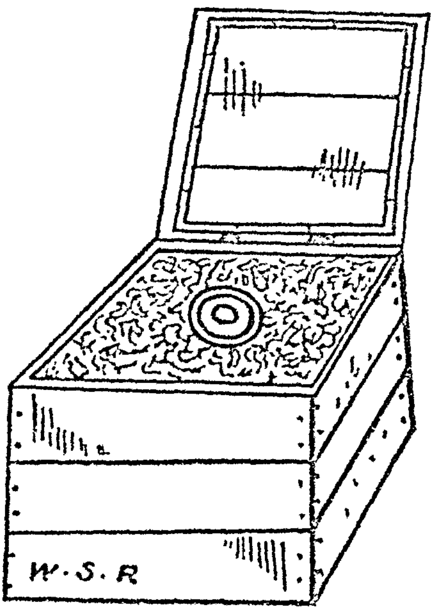
(*v*) Pour the evening milk unboiled, into the *chati* Open the hay box, remove the *kaharni*, and pour the milk into the evening milk already in the *chati* Add the "starter" and do the churning next morning in the usual manner

The above is an extremely simple process, and provided that sufficient care is taken to keep the hay or *bhusa* used, perfectly dry, it can be carried out by anyone with immediate success

Hay-boxes may also be made of metal, or may be built of *kacha* or *pucca* brick adjacent to the cooking place, but they must be provided with well fitting lids.

If the hay-box is adopted as the general method of heating milk, the provision of special fire-places, or *haras*, or *dudarnas* for heating milk, will become quite unnecessary. In most families, a meal is cooked early in the mornings, and the fire used for this can afterwards be utilised for bringing the milk in the *kaharni* to the boil, by the expenditure of only a very little more fuel. The wasteful habit of simmering milk for long periods on a separate fire can be totally discontinued where the hay-box is brought into daily use.

The sketch given below depicts a hay-box made from a packing case, with the *kaharni* of hot milk inside.



HAY-BOX

GOVERNMENT CATTLE FARM, HISSAR

Results of comparative trials of milk heating "Hay box" v "Indigenous" methods

Detail	Unit	1 Morning milk brought to boil, allowed to go cold, evening milk added unboiled	2 Morning milk simmered all day and evening milk boiled and added	2 A Morning milk brought to boil and placed in Hay-box, evening milk boiled and added	3 Morning milk simmered all day and evening milk added unboiled	3 A Morning milk brought to boil and placed in Hay-box; evening milk added unboiled	Remarks
1. Total morning and evening milk used	lb	60	60	60	60	60	The fat percentage of the milk was the same in all cases.
2. Amount of water added .	lb		6		6	..	
3. Total fuel for heating milk .	lb	8	14·5	7·5	15	7·5	
4. Total butter produced .	lb.	3·159	3·009	3·495	3·063	3·404	The fuel used for making the *ghi* is not included.
5. Amount of water added for churning	lb	18	15	18	12	18	
6. Amount of *ghi* produced	lb	2·383	2·317	2·478	2·417	2·537	
7. Amount of *lassi* produced .	lb	75·0	71·5	74·3	69·0	75·0	The fuel used in all cases was cowdung cake (*upla*)
8. Milk to make 1 lb *ghi* .	lb	25·178	25·564	24·213	24·824	23·670	
9. Taste of butter and *ghi* .	lb.	Good . .	Good . .	Good . .	Good . .	Good	
10. Taste of *lassi* . . .	lb.	Good . .	Good . .	Very good .	Good .	Very good	

SUMMARY OF RESULTS

Method No 3 A first place
" " 2 A second place
" " 3 third place
" " 1 fourth place
" " 2 fifth place

NOTES

BULLETINS ON SEED PRODUCTION OF HERBAGE AND FORAGE PLANTS

A SERIES of six Bulletins has been published by the Imperial Bureau of Herbage Plants, Aberystwyth, on questions relating to the production of seed of herbage and forage plants. In view of the number of bred and selected strains now being reproduced for seed in different parts of the world, the agronomical technique to be used in the production of seed is an important question at the present time. The Bulletins are intended for the use of agricultural research workers, advisers, seed producers and seedsmen, and will also be of value to practical farmers, who will find information on many points which are important in the production of good crops of clean seed of grasses, clovers and other forage plants under a wide range of climatic and other conditions.

The chief Bulletins in the group are Nos. 19 (5/-), 22(5/-), and 23 (5/-). Bulletin 19 describes the technique used in producing seed of a number of grasses in all parts of the world, while Bulletin 23 is a companion issue dealing with legume (clovers, lucerne, etc.,) seed production. Bulletin 22, by Gwilym Evans, Officer-in-charge of Seed Production on the Welsh Plant Breeding Station, contains a description of the technique which has been evolved for producing seed of the various hay and pasture strains bred at the Station. Special consideration is given to the dates and rates of sowing, isolation, manures and fertilizers, harvesting, seed conditioning and storing. The Bulletin contains a brief statement of the new scheme for marketing seed of these bred strains, in which collaboration will be assured between the Station on the one hand and the Seed Trade and the Growers' Association on the other ; a complete scheme of inspection and certification will be incorporated. The final section of Bulletin 22 is a list of the bred strains released by the Welsh Plant Breeding Station, with a brief statement of the characteristics of each.

The other Bulletins on the subject of seed production are No. 20(2/6) on insects and other pests injurious to the production of seed in herbage and forage crops, by H. F. Barnes of the Entomology Department, Rothamsted Experimental Station, Bulletin 21(1/-), on the influence of climatic conditions on type composition, by N. Sylvén of the Plant Breeding Station, Svalöf, Sweden, and No. 24(2/-) on the collection of native grass seed in the Great Plains, U. S. A., by F. J. Crider and M. M. Hoover. This last publication will be of particular interest to persons in the more arid grassland countries, where erosion is a problem, as

it contains illustrations of the typical grasses of the Great Plains, which are being reproduced in connection with the soil conservation programme.

Copies of these Bulletins are obtainable from the Chief Officer, Imperial Bureau for Herbage Plants, Aberystwyth

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THE INTERNATIONAL INSTITUTE OF AGRICULTURE

THE following "Notes on the International Institute of Agriculture" are reprinted from the supplement pages of the "International Bulletin of Plant Protection", January, 1938, issued by that Institute

General Assembly (May 1938).—The XIVth General Assembly of the International Institute of Agriculture will commence on Monday, 23 May 1938, at 10 A M at the Institute with the agenda established by the Permanent Committee and approved by the adhering Governments

Permanent Committee (Meeting of December 1937).—The Permanent Committee of the International Institute of Agriculture held the last meeting of the year on 13, 14 and 15 December

The Permanent Committee in addition to the usual questions the Secretary General's Report on the Services and Administration, Financial and staff questions—examined the programme of the next General Assembly (May 1938) the results of the Conference of Agricultural Statisticians for the World Agricultural Census of 1940 the participation of the representatives of the Institute in the next meeting of the Permanent Agricultural Commission of the International Labour Office (Geneva February 1938), etc

Publications of the Institute.—During the past three years readers of "Government Measures Affecting Agricultural Prices" have been kept informed of governmental legislation and activity regarding the production of, and trade in, agricultural products A quarterly publication such as this, however, does not enable a sufficient quantity of material to be published, nor does it permit rapid notification of official modifications which are being made so frequently The International Institute of Agriculture has, therefore, decided to continue publication of decisions which might affect agricultural prices in the form of a monthly "International Chronicle of Agriculture", which as from January 1938, will be incorporated in the "Monthly Bulletin of Agricultural Economics and Sociology".

The list of books presented to the Library will appear as from January 1938, on these coloured sheets Consequently instead of the book list, up to the present published separately in the two Bulletins (Economic and Technical), there will now be one list, in which the books will be classified under authors' names and in alphabetical order

For the future, the prices indicated on the Institute's *publications* will be *prices* (post free).

The International Conference of Agricultural Statisticians for the World ricultural Census of 1940.—The International Conference of Agricultural atisticians for the Second World Agricultural Census was held in December the International Institute of Agriculture.

The Conference held nine meetings from 13th December during which it dissed suggestions put forward by the various Governments and by the statistins present for the revision of the draft Standard Form for the World Agricultural ensus of 1940 which had been prepared by the International Institute of Agriulture after the first Conference held in October 1936. The execution of the ensus and the presentation of its results were also under discussion.

After a thorough examination and exchange of views the Conference made number of recommendations of a technical or general nature which the International Institute of Agriculture will put in a concrete form. The programme for the World Agricultural Census of 1940 will be prepared in its final form on the lines of these decisions and will then be recommended to the various Governments.

Meetings of Commissions of Experts.—During the month of December, there took place at the International Institute of Agriculture several meetings of experts, called together for the study of the technical aspects of certain problems.

A *Small Commission of experts in Cereal Chemistry* was convened by the Institute and met on 6 and 7 December, to study the technical aspects of the action to be taken as the result of a Resolution passed by the International Congress of Agriculture of Budapest (1934) with a view to the study of the best means for bringing about an international understanding with regard to the question of the standardization of the methods of analysis of wheats.

This Commission, whose work was of a quite preliminary character, presented a Report which is submitted to all the Governments of the Member States.

The Governments have been requested to let the Institute know their views on the different questions mentioned in this report.

After ascertaining the views expressed by the Governments, the Permanent Committee of the Institute will decide on the action to be taken.

Wishing to improve the work of the Institute in the field of *Tropical and Sub-Tropical Agriculture* and in *Horticulture*, the Permanent Committee convened *two Commissions of experts, for the purpose of indicating those points comprised* in these sectors on which it would be advisable for the work of the Institute to be intensified. These two Commissions which met in December 1937, have presented two interesting advisory reports, which will come up for consideration by the Permanent Committee at its March meeting.

The Institute also announces the publication of the following books —

1 La Legislation du Commerce des Plantes (published in French only) (In the press)

This monograph will appear during the first quarter of 1938 and this new edition (second) is considerably more complete than the preceding one In fact the volume in preparation includes sixty countries instead of thirty seven and it may be said that it is truly universal

2 Recueil de Coefficients et Dequivalences (published in French only), Rome 1937 296 pp Price 15 Lire

This new edition (fifth) comprises far more detailed information than was published in 1922 It gives an account of the system of weights and measures in use in various countries and contains a brief summary of the numerous changes in the value of different currencies since the pre war period up to the present day

3 International Year book of Agricultural Statistics, 1937 38, Volume XXI about 1000 pp Price 100 Lire, cloth bound 105 Lire (post free)

This book now in its 20th Volume (the first volume was published in 1912) is an indispensable work for all who undertake studies having any connection with production trade or prices of agricultural products It is hoped to publish this edition for 1937 38 during the month of May next

4 Annuaire International de Legislation Agricole, 1937 Volume XXVII about 1000 pp (In French only) Price 85 Lire, cloth bound 90 Lire (post free)

This book represents an account of the complete collection of laws classified systematically in the different volumes from 1911 up to the present time, a reference book which Governments and those interested in the study of agricultural questions considered indispensable for the compilation of new draft laws, and for the completion of any study which involves a knowledge of agricultural legislation of the different nations

In addition, a few books of a new series of world production and trade in agricultural products are published These represent the result of a new plan of work by the Institute inaugurated in 1934 to show the position of agriculture in relation to the International trade They are designed to provide a document to show changes and effects of various economic policies and their influence upon the welfare of the agricultural industry

Already issued—

1 World Cotton Production and Trade (Rome, 1936, xii + 464 pp 8vo with maps and diagrams) Price 30 Lire

2—International Trade in Meat (Rome, 1936, xii+424 pp 8v with diagrams Price 25 Lire

In preparation :

3. World Production of Meat.
4. Fats and Oils : World Production and Trade.

The various publications of the Institute may be obtained in London from Iessrs. P. S. King and Son, Westminster, or may be ordered direct from the Ins- itute or through any bookseller.

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:HANGES IN TITLES OF SOME OF THE IMPERIAL AGRICULTURAL BUREAUX

In pursuance of the recommendations of the British Commonwealth Scientific Conference, 1936, the Executive Council of the Imperial Agricultural Bureaux have decided to adopt the following revised titles for certain bureaux with effect from the first January 1938 :—

(*a*) The Imperial Bureau of Plant Breeding and Genetics (at Cambridge).
(*b*) The Imperial Bureau of Pastures and Forage Crops (at Aberystwyth).
(*c*) The Imperial Bureau of Horticulture and Plantation Crops (at East Malling).
(*d*) The Imperial Bureau of Animal Breeding and Genetics (at Edinburgh).
(*e*) The Imperial Bureau of Agricultural Parasitology (Helminthology (at St. Albans).

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THE THIRD INTERNATIONAL CONGRESS FOR MICROBIOLOGY

The Third International Congress for Microbiology will be held at the Waldorf-Astoria Hotel. New York City, September 2-9, 1939, under the auspices of the International Association of Microbiologists.

T. M. Rivers, M.D., President, Rockefeller Institute for Medical Research York Avenue and 66th Street, New York City.

M. H. Dawson, M.D., General Secretary, College of Physicians and Surgeons, 620 West 168th Street, New York City.

Kenneth Goodner, Ph.D., General Treasurer, Rockefeller Institute for Medical Research, York Avenue and 66th Street, New York City.

The Congress will be composed of the following nine sections :—

1. General Biology : Variation and Taxonomy. Convener : C. E. A. Winslow.
2. General Biology : Microbiological Chemistry and Physiology. Convener Stuart Mudd.

3 Viruses and Viral Diseases Convener W A Sawyer
4 Rickettsiae and Rickettsial Diseases Convener Hans Zinsser
5 Protozoology and Parasitology Convener H W Stunkard
6 Fungi and Fungous Diseases Convener B O Dodge
7 Medical and Veterinary Bacteriology Convener F P Gay
8 Agricultural and Industrial Microbiology Convener S A Waksman
9 Immunology Convener M Heidelberger

Registration fee will be $5 00 which will not include the cost of a banquet ticket or a copy of the Proceedings of the Congress

A World s Fair will be held in New York City during the summer of 1939 Consequently those who wish to attend the Congress for Microbiology should make plans promptly The American Express Co the official travel agency for the Congress will be glad to assist in such plans

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THE MARGIN BETWEEN PRODUCERS AND CONSUMERS PRICES OF CERTAIN FOODSTUFFS

The following communication has been received from the Press Bureau of the International Institute of Agriculture Villa Umberto Rome —

This report undertaken in connection with the International Institute of Agriculture s work for the League of Nations Nutrition Commission is designed to collect summarize and interpret data relating to the costs of distribution of foodstuffs It contains information relating to twelve countries some of which is original and the remainder only being available in scattered and not easily accessible documents

The main problems which the report discusses are the size composition and movement of the distributive margin the degree to which and the reasons wherefor the margin may be excessive and the possibility and methods for reducing them and thereby the cost of foodstuffs to the consumer It will thus be of interest not only to producers and distributors but also to consumers and their organisations whose interest in the reduction of the prices of foodstuffs is becoming increasingly marked in view of the rising tendency of the cost of living in most countries of the world The importance of the questions is shown by the statistics amply provided in the report which show that in some countries the cost of distribution in all the processes involved in the passage of a given commodity from farmer to consumer averages from forty to sixty per cent of the consumer s price Further the report shows that for a whole series of seasons the long term trend is towards a continual increase in the size of the margin

The division of the work into two parts, one containing separately the informa-
on relating to each country and the other presenting the conclusions which a llective study of such information reveals, makes possible the separation of oblems of a general interest from those of the more limited national character id will facilitate its use for reference purposes.

The report concludes that, there are sufficient possibilities of reduction of istributive costs to justify the belief which underlay the proposal of the League ommittee on Nutrition to the Institute to collect material on the distributive argin—the belief, namely, that research in this field, continued with appropriate ction, could contribute to lowering prices of necessary goods to the consumer, nd to the improvement of nutrition standards.

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FARM ACCOUNTANCY STATISTICS FOR 1932-33 AND 1933-34

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

The International Institute of Agriculture at Rome is about to publish the sixth volume of the "Farm Accountancy Statistics". This publication contains tables bringing together the chief agricultural statistics for about twenty European countries and for the United States of America. It makes available in a form which facilitates comparisons as much as possible a series of international statistics. This publication is all the more important as it throws light upon a large number of the most difficult problems of rural economy, of agricultural policy and also upon the trends in farming under the influence of variable market conditions.

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LIVE-STOCK INSURANCE IN GERMANY

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

In the "Bulletin of Agricultural Economics and Sociology" the International Institute of Agriculture has published a study of live-stock insurance in Germany. In the first part, devoted to private insurance, are discussed the principal branches of this type of insurance, that is to say insurance against the death of live-stock, and insurance of slaughter animals. The articles discuss not only the origin and development of these forms of insurance, giving two complete statistical tables, but also that which concerns the insurance contract, the regulation of societies and legislation against live-stock diseases.

The second part is devoted firstly to public insurance of live stock practised in Germany in Bavaria and Thuringia and by two Prussian public fire insurance companies and then to re insurance of small local societies which has taken on various forms in Germany and which exists at the present time in Baden Bavaria the Free State of Saxony and finally in Berlin under the form of a share company created recently by the agricultural corporation which owns the total capital of this society which has replaced several re assurance organisations existing in several states

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BIHAR VETERINARY COLLEGE, PATNA

The following notification has been received from the Principal, Bihar Veterinary College Patna —

The next session of the Bihar Veterinary College will commence from the 1st July 1938

1 A candidate desiring admission should submit his application on the prescribed form together with the following certificates in original, so as to reach the Principal on or before the 1st June 1938

(a) Age and moral character certificate from the Headmaster of the school or Principal of the college which he last attended

(b) University certificate or a certificate from the School or University authorities to show that he has passed the Matriculation Examination

(c) Medical certificate of fitness from an Assistant Surgeon

(d) Letter from his guardian stating that all expenses incurred by his ward during the latter s period of study at the college will be paid

(e) Letter of identification from some well known person stating that the candidate is known to him and the statements made in the application form are correct

2 A candidate for a District Board stipend to assist him while under training at the college should apply *in the first instance* to the Chairman of his home district board with necessary certificates as soon as possible so that when selected he may be interviewed and approved by the Director of Veterinary Services, Bihar before he is recommended for admission Such a candidate should in addition to the certificates required in para 1, produce at the time of admission a letter from the Director of Veterinary Services, Bihar, or the Chairman, District Board concerned regarding his selection as a stipendiary

3. An applicant must be a Matriculate of a recognised University. Prefer- ce will be given to a candidate who has passed the I. A. or I. Sc. Examination. good knowledge of English is essential. Height should not be under 5′ 4″ and est unexpanded, not less than 30 inches. A candidate must not be below 16 and or 25 years of age.

4. A non-stipendiary candidate will have to appear before the Governing ody of the college when called for interview.

5. Fees must be paid in advance according to the scale under rule 8 of the ollege rules, the initial payment due at the time of admission being Rs. 35-8-0 aly.

6. A candidate on admission will have to reside in the college hostel unless xempted under special circumstances.

7. Admission forms may be had free on application to the Principal. *Pros- ctus will be supplied on receipt of As. 4 by money order for each copy required.*

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STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the "Monthly Statistics of the Production of Certain Selected Industries of India, for May, June, July and August, 1937"

Detailed statement of the quantity and description of jute manufactures produced in India

Description		Month of May 1936	Month of May 1937	Month of June 1936	Month of June 1937	Month of July 1936	Month of July 1937	Month of August 1936	Month of August 1937
I Twist and Yarn	tons	3 979	3 793	4 303	4 387	4 662	4 502	4 4[illegible]9	4 533
II Manufactures—									
Canvas	tons	227	309	223	300	221	264	1[illegible]5	306
	yds	400 540	636 260	426 018	593 636	434 679	495 602	330 394	668 331
Gunny Bags—									
(a) Hessian	tons	5 469	4 802	6 130	5 307	6 772	5 024	5 530	4 366
	No.	11 144 627	11 373 243	11 396 533	11 393 721	12 980 150	10 057 495	11 069 935	9 047 982
(b) Sacking	tons	49 637	52 141	51 861	58 898	56 470	60 511	53 367	59 363
	No.	46 234 577	50 010 832	47 385 179	56 605 718	53 197 968	59 062 3[illegible]0	52 223 532	58 02[illegible] 905
Gunny Cloth—									
(a) Hessian	tons	3[illegible] 505	36 864	33 917	41 021	39 711	42 945	39 904	43 751
	yds	125 732 311	142 430 307	131 773 875	158 547 567	151 814 618	165 751 09[illegible]	153 238 966	168 068 7[illegible]4
(b) Sacking	tons	2 092	2 672	2 820	2 953	2 483	2 627	2 [illegible]36	3 011
	yds	4 713 841	5 957 [illegible]86	6 401 183	6 660 839	5 508 689	6 263 635	5 220 15[illegible]	7 [illegible]91 480
Other Manufactures including Rope and Twine	tons	430	569	519	482	515	356	558	396
Total	tons	94 339*	101 160	99 773*	113 348	110 834*	116 2[illegible]9	106 220*	115 726
	yds	130 846 802*	149 023 853	138 601 076*	165 802 042	167 757 986*	172 510 829	158 798 512	176 [illegible] 585
	No	67,379 204*	61 384 075	[illegible]8 781 712*	67 999 439	66 178,118	69 119 [illegible]	6[illegible] 467*	[illegible]

* [illegible]

Detailed statement of the

Description	Month of May		Month of June		Month of July		Month of August	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Sulphuric Acid—								
Ordinary or non-fuming	27,304*	58,458	37,477*	50,359	40,099*	42,127	54,110*	52,736

* Revised.

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of May		Month of June		Month of July		Month of August	
	1936	1937	1936	1937	1936	1937	1936	1937
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Ammonium Sulphate—								
Neutral	1,231	1,280	949	1,260	986	1,327	1,283	1,497
Acid	100	50	585	...	473	52	182	33

Detailed statement of the quantity and description of sugar produced in India

Description	Month of May 1936	Month of May 1937	Month of June 1936	Month of June 1937	Month of July 1936	Month of July 1937	Month of August 1936	Month of August 1937
	Cwts	Cwts	Cwts	Cwts	Cwts	Cwts	Cwts	Cwts
1 *Khandsari* Sugar*	(a) 6 717	4 [illegible]03	(a) 3 100	1 [illegible]61	(a)1 536	1 367	1 3[illegible]9	453
2 All other Sugar except Palmyra Sugar	(b)[illegible]39 96[illegible]	(b)1 6[illegible]3 [illegible]15	14[illegible] [illegible]42	2[illegible] 690	(a) 14[illegible] 8[illegible]	77 [illegible]19	166 9[illegible]7	109 847
3 Palmyra Sugar	(a) 5 091	[illegible]1	6 601	1 0[illegible]	19 5[illegible]9	5 669	31 [illegible]86	30 504
Total	[illegible]51 668	1 65[illegible] [illegible]2	(a) 155 643	[illegible]6 305	(a)10[illegible] 949	84 [illegible]	199 6[illegible]	140 804

* Figures relate to excise issues only (a) Revised (b) Excludes production in Burma

Detailed statement of the quantity and description of wheat flour milled in India

Description	Month of May 1936	Month of May 1937	Month of June 1936	Month of June 1937	Month of July 1936	Month of July 1937	Month of August 1936	Month of August 1937
	Mds	Mds	Mds	Mds	Mds	Mds.	Mds	Mds
Flour	420 159	503 758	391 565	45[illegible] 710	437 699	540 835	500 149	550 349
Atta — High grade	[illegible]69 133	290 567	277 692	269 319	295,377	314 [illegible]49	[illegible]88 165	308 [illegible]89
Atta — Low grade	140 051	155 [illegible]32	123 448	156 381	1[illegible]8 835	164 421	141 719	159 220
Bran	204 120	221 080	103 5[illegible]6	[illegible]08 154	213 769	256 894	23[illegible],093	254 541
Soojee	37 985	59 108	38 535	63 672	41 855	73 [illegible]05	48 054	64 066
Others	6 010	8 564	8 415	11 656	[illegible] 926	8 905	7 864	9 988
Total	1 087 370*	1 228 899	1 031 831*	1 161 900	1 124 [illegible]61*	1 389 [illegible]	1 218 044*	1 [illegible]85 [illegible]

*Revised

ABSTRACTS

Inheritance of earliness in United Provinces rices, II. R. L. Sethi, B. L. Sethi and T. R. Mehta. (*Ind. J. Agri. Sci.* 8, 1)

The results of a study of earliness made in four rice crosses with *sathi* rice as one of the parents have been described. Data up to the F_6 generation have been presented. The frequency distribution of flowering duration in F_2 was continuous and extended from the lower extreme of the early parent to well beyond the upper extreme of the later parent. The F_2 duration tended to be reproduced in the F_3 generation. The standard deviations of the flowering durations of the different F_3 families did not exhibit any relation to the corresponding mean values. The inheritance was governed by several cumulative genes. (*Authors' abstract*)

Cotton botany and the spinning value and hair properties of cotton lint. J. B. Hutchinson and G. K. Govande. (*Ind. J. Agric. Sci.* 8, 21)

The technological data available for standard Indian cottons have been analysed according to botanical relationships. It is shown that the different botanical types differ greatly in mean spinning values and hair properties. The greatest differences are between the short, coarse, low-spinning *G. arboreum* var. *neglectum* forma *bengalensis* of northern India, and the other botanical groups. The other groups differ in hair weight, the Uplands being the finest and the *herbaceums* the coarsest, but have very similar hair lengths and spinning values.

The data show that the reputation of India as a producer of coarse-stapled cotton depends almost entirely on one of the four botanical types now cultivated. As it has already been shown that the coarse northern *arboreum* type has invaded most of the areas in which it now predominates in quite recent times, it is concluded that India has become a producer of coarse cottons by force of economic circumstances, and not on account of any inferiority in her indigenous cottons.

It is shown that the introduced Upland cottons differ very little from the superior indigenous types in spinning value. If adequate botanical and technological surveys are made of the range of variability available in the indigenous species, improvement in quality is likely to be attained as rapidly with them as with exotic types.

The relative importance of differences in crop variety, and in environment is examined, and it is shown that differences in hair properties and spinning value due to differences in environment are very small compared with those due to crop variety. Also, correlations between hair properties and spinning value are very much higher when calculated from differences in crop variety than from differences in environment. This is fortunate from the plant breeding point of view, since it minimises the errors, which

will arise from the estimation of strain differences in spinning value from hair characters measured on small quantities of cotton from progeny rows

The swollen hair diameter method of determining fineness is discussed and it is concluded that, if it is satisfactory after more extended trial, it will put the quantitative study of fineness within the reach of the plant breeder Its importance is emphasised in enabling the plant breeder to select for high ginning percentage without the risk of loss of quality (*Authors abstract*)

Alternaria blight of cumin B N UPPAL, M K PATEL and M N KAMAT (*Ind J Agric Sci* **8**, 49)

ALTERNARIA blight of cumin occurs sporadically in the Kaira district in Gujarat. The disease attacks the aerial parts of the plant In the early stages of attack the affected plants show minute whitish necrotic areas which turn purple with age and later become brown and finally black These areas are first exceedingly small in extent but, as they enlarge, become obliterated in the general invasion The disease ultimately kills the affected parts, particularly the succulent leaves and blossoms The attacked plants bear no seed, but, if some seed is produced, it is usually shrivelled, dark coloured and of poor germinability

The fungus is extremely pathogenic on cumin, but failed to pass to other plants in cross inoculation tests The fungus is able to oversummer in plant residues in the field. It is probable that infected seed also plays an important part in the perennation of the fungus and in initiating primary infection

The mycelium of the fungus produces the enzymes emulsin trypsin, erepsin amylase, lipase and inulase The morphology and cultural characters of the fungus are described The fungus is considered to be a new species of *Alternaria* and is named *Alternaria burnsii*, with English and Latin descriptions (*Authors' abstract*)

The *tur*-pod fly, *Agromyza obtusa* Mall, a pest of *Cajanus Cajan* TASKHIR AHMAD (*Ind J Agric Sci* **8**, 63)

THE *tur* pod fly, an important pest of *Cajanus Cajan* in several parts of India has been identified as *Agromyza obtusa* Mall Though distributed throughout the country it is serious only during winter and spring During the year 1935 36 it was estimated that the maximum damage to *tur* pods at Pusa (Bihar) reached as high as sixty three per cent.

Eggs are laid inside pods and the larvae on hatching bore into the seed and feed there till they are full grown They pupate within the pod During March and April the pre imaginal period is about three weeks The adult flies begin to copulate and oviposit almost immediately after emergence

The activity of the pest is at a very low ebb during December and January when affected pods should be collected and burnt A chalcid larval parasite has been noticed breeding in large numbers and seems to exercise considerable check on the activity of the pest in nature (*Author's abstract*)

:udies in the preservation of fruit juices, I. Some observations on the *preparation* and *preservation of* citrus fruit squashes. LAL SINGH and GIRDHARI LAL. (*Ind. J. Agric. Sci.* 8, 77)

ON the basis of analyses of samples of eighteen different brands of citrus squashes ,vailable in the market, various sets of orange and lemon squashes with different sugar oncentrations (35°, 45° and 65° balling strength) preserved by different methods of)reservation, were prepared and stored at room temperature for a period of 1¼ year. Their behaviour during storage has shown that :—

1. Citrus fruit squashes with high sugar content (65°B) retain their fresh-fruit character and stability to a marked degree.
2. Addition of thoroughly ground and strained peel emulsion of two to four per cent fruits used for juice extraction, considerably improves the flavour and aroma of the bottled product.
3. Preservation with sulphur dioxide yields a product superior in taste, flavour and odour to that preservd with sodium benzoate or Pasteurization.
4. For effective preservation, maximum permitted concentration of sulphur dioxide (350 p.p.m) can be fairly diminished (100—200 p.p.m.) in squashes with high sugar content.
5. An examination of samples of squashes occasionally opened and re-corked during summer has shown that the chemically preserved squash has far better keeping qualities than the Pasteurized squash.
6. Squashes other than those preserved with sulphur dioxide undergo marked colour changes (light, yellow to deep brown) in 1¼ year's storage.

Method of preparation and standardization of orange and lemon squashes has been given, their recipes and cost of production have been worked out. (*Authors' abstract*)

A form of verminous ophthalmia in equines. P. R. KRISHNA IYER. (*Ind. J. Vet. Sci. & Anim. Husb.* 8, 3)

UNDER the name of 'periodic ophthalmia', a disease affecting the eyes of horses in the stud farms at Montgomery and Probynabad in the Punjab has been known for some years. The disease is of a recurrent nature and terminates in the affected animals becoming blind. The disease occurs at all times of the year, and no seasonal incidence has been observed. Mechanical irritation by flies and dust, bacteria and dietetic deficiency were suspected to be concerned in the causation, but these agents have been eliminated. Histopathological examination has revealed the disease to be of verminous origin, microfilaria being constantly present in sections of the affected eyes, and lachrymal glands. Intense eosinophilia, neutrophile and lymphocytic infiltration and fibroblastic activity are some of the other features seen. The transmitting agent appears to be a biting fly. From the morphological features and unsheathed character, the microfilaria appears to belong to some onchocercoid worm, but attempts at specific determination have so far failed. Experience gained so far tends to show that treatment with antimosan and other antimony preparations have an inhibitory effect on the progress of the condition. (*Author's abstract*)

A comparative study of the colostrum of the dairy cow and the dairy buffalo V SIVASUBRAMANIAN and C W DOVER. (*Ind J Vet Sci & Anim Husb* 8, 29)

THE above study has been made on three Sindhi cows and three Murrah buffaloes maintained at the Imperial Dairy Institute Farm Bangalore Samples of colostrum, which were drawn from all the four quarters of the udder were taken immediately after calving and every six hours for the first day after calving, every twelve hours for the next two days and after twenty four hours on the fourth day, by which time the milk was found to have become normal.

In view of the fact that colostrum is rich in globulin, which in turn is responsible for the transmission of the maternal antibodies to the young, a separate analysis of this protein was made

Except in regard to the fat content the results follow about the same order in all the cases.

Buffaloes' colostrum is higher in specific gravity, acidity, sodium chloride, total solids, total protein, casein, albumin, globulin and ash than cows' colostrum, while in lactose it is lower

In both animals there is a progressive fall in all the constituents except lactose which shows an increase and fat which is irregular

Globulin constitutes the major part of the total protein of both kinds of colostrum soon after calving, and its decrease is more marked during the first twenty four hours than during the remainder of the colostral period

Buffaloes' colostrum changes to normal milk in about three days, while cows colostrum takes about four days. (*Authors' abstract*)

The incidence of *Salmonella enteritidis* var *dublin* in pyosepticaemia of calves in India. V R RAJAGOPALAN (*Ind J. Vet Sci & Anim Husb* 8, 33)

AN organism isolated from cases of pyosepticaemia in calves, by Mr Shirlaw at Lahore, has been typed as *Salmonella enteritidis* var *dublin*, after a detailed study of its morphological, cultural and biochemical properties, as also of its antigenic constituents Its antigenic structure has been found to be IX gp —, by a series of serological analysis This is the first time that the incidence of this organism is recorded in India. (*Author's abstract*)

A study of the mineral assimilation of growing calves A VISWANATHA IYER and N KRISHNA AYYAR (*Ind J Vet Sci & Anim Husb* 8, 43)

EIGHT bull calves fourteen to seventeen months old were selected and divided into two similar groups of four each. One group received the basal ration, which consisted of hay, guinea grass (green) wheat bran and groundnut cake and the other group in addition to the basal ration a supplement of thirty grms of calcium phosphate Three digestion and mineral balance experiments were carried out

After seventeen weeks of feeding, the groups were reversed, the animals receiving ıe basal ration now get the mineral supplement.

From the digestibility figures, it becomes evident (1) that even with the larger ıtake of phosphoric acid, there has not been any change in the digestibility of protein, :) that when the minerals are sufficient in the feed itself, a supplement of calcium hosphate does not show any visible effect except for the fact that the animals receivıg the supplement retain more calcium and phosphorus in their systems. (*Authors' bstract*)

THE following abstracts of articles from the *Indian Forester* have been reeived from the President, Forest Research Institute, Dehra Dun, and are pubshed here as they are of interest to agricultural workers :—

ıfforestation of the Ridge at Delhi. R. N. PARKER (*Ind. For.* LXII (11) : Pp. 671—72. 1936)

DESCRIBES results of planting after sixteen years on the dry rocky "Ridge" at)elhi. Successful species are listed, *Prosopis juliflora* and *Acacia ferruginea* being among the best. (*M. V. Laurie*)

Village uplift and its connection with forestry. K. D. JOSHI (*Ind. For.* LXIII (1) : Pp. 34—36. 1937)

THE necessity for co-operation with the forest department and with local forest officers in village uplift schemes is emphasised. (*M. V. Laurie*)

Frost in the Central Provinces. C. M. HARLOW. (*Ind. For.* LXIII (1) : Pp. 1—14. 1937)

THE note gives details of the frosts which have damaged the teak forests of the Western Circle of the Central Provinces and Berar in recent years. Records of earlier frosts are also given. Attention is drawn to the apparent fact that frosts earlier than January do less damage than later frosts : the period of great danger seems to be after about the 10th January. Minimum temperatures recorded at Khandwa over a series of years are then examined and an attempt made to correlate them with the years in which serious frost damage has been known to occur. One aspect of the effect of such frosts on the normal forest undercurrent methods of management is then given. (*Author's abstract*)

Can you use a divining rod? H G CHAMPION (*Ind For* LXIII (2) Pp 89—92 1937)

DESCRIBES the claims made by K M Muller the European diviner to be able to map 'earth rays' and to explain growth variations by them The claims were not substantiated under test (Fabricius) but ingenious explanations of the failures were put forward (*M V Laurie*)

Ecology and culture of *kuth* SHER SINGH. (*Ind For* LXI (2) Pp 80—89/ 573—88 1935 LXII (2) Pp 80—89 3 plates 1936)

'KUTH' (*Sassaurea lappa*) is predominantly moisture loving It grows in the birch and high level fir zones from 8 000 to 12 000 feet elevation in the Kashmir Himalayas. 10 000 to 11,000 feet is the zone for optimum growth It is a mesophyte and likes the light shade of birch It is very susceptible to grazing and indicator plants of areas suitable for *kuth* but from which it has been exterminated by grazing are listed *Kuth* unlike its associates flowers late, in the month of August and even later at higher elevations (*M V Laurie*)

A short note on *simul* plantations in Assam. J N DAS (*Ind For* LXII (5) 1 plate Pp 257—60 1936)

PLANTATIONS of *simul* (*Bombax malabaricum*) should not be made at a closer spacing than about 22 ft × 22 ft The final number of trees per acre for a mean girth at 4 ft 6 in of six feet is about 22 trees per acre equivalent to 44 ft × 44 ft espacement. The rotation for this size is about twenty five years (*M V. Laurie*)

Note on *Lantana camara* in the Simla Hills N G PRING (*Ind For* LXII (10) Plate 1 Pp 603--8 1936)

LANTANA was introduced by missionaries at Sabathu during the 19th century, and was planted extensively as a hedge plant It now occupies some 20 square miles in Baghal State It does not occur higher than about 4,000 feet elevation While generally regarded as a pest, it is a safeguard against over grazing and erosion, and may even be an asset Attempts at eradicating it are described (*M V. Laurie*)

Indian plants reputed as fish poisons M B RAIZADA and B S VARMA (*Ind For* LXIII (4) Pp 198—218 1937)

FIFTY THREE plants that are reputed to be used as fish poisons in India are compiled in this paper A brief description of each plant, its vernacular name, habitat, area of abundance its part or parts that are used for the purpose and its chemical constituent are given in a tabular form It is stated in the introduction how several fish poisons have been used as insecticide (*S Krishna*)

pratense) and meadow fescue (*Festuca pratensis*) to clearly demonstrate the danger of growing strains for seed outside their special growing districts According to the author this is specially the case if it is desired to keep up and further to fix those characters of strains which are specially adapted to the climatic conditions of the respective districts He states that when a forage crop strain has been bred within regions hardly adapted for seed production on a large scale it is often necessary to transfer the main propagation of the strain to a more favourable place outside its natural growing district The note is illustrated and lays emphasis on the fact that different natural selection caused by climatic conditions is a factor which must be taken into account The experience of rational propagation of pure bred herbage plant strains at Svalof has definitely indicated that the longer a forage plant strain is grown outside its proper growing district the greater must be the importance of this natural selection [R L S]

Technique of Grass Seed Production at the Welsh Plant Breeding Station By GWILYM EVANS Officer in charge of Seed Production Welsh Plant Breeding Station Aberystwyth (Herbage Publication Series Bulletin No 2? Published by the Imperial Bureau of Plant Genetics Herbage Plants Aberystwyth, Great Britain August 1937) Pp 36+8 plates Price 5s

THE Bulletin contains a comprehensive description of the technique which has been evolved for producing seed of the various hay and grass pastures bred at the Station The ground covered is fairly extensive and the subject is divided into six sections each giving a detailed account of different aspects of producing pasture strains The initial stages of seed multiplication of a new grass strain is achieved by three stages i e the first from limited number of finally selected plants the second on a limited scale and the third in terms of several fields for each strain In the first stage one of the first considerations is good isolation This is chiefly achieved by means of glass houses Alternative to this is to grow the original plants in the open and to have separate seed islands situated at distances from one another An account of harvesting threshing and cleaning as done for glass houses and the first multiplication grass island crops is given Certain aspects of the second multiplication stage which require greater circumspection than in the third stage such as the selection of suitable growers and the optimum quantity of the seed grown per acre which varies not only with species and strains but also with the conditions under which particular strains grown are described An account of the third multiplication stage follows next and much valuable information is contained in this chapter Starting with an account of selection of centres for growing pedigree seed to the last stage of storing of the seed, it gives

n interesting and illustrated account of the salient features connected with ifferent aspects of the growth of the crop. The first section of this chapter deals vith the difficulties encountered in the choice of districts. This is followed by a escription of soil and climate most suited to the growing of satisfactory stocks of edigree grass seed. Previous crops and what effect they have on (1) soil fertility, 2) general cleanliness of the land and (3) seed content of the soil are explained n the next section. The author states that an inquiry must be made into the ropping history of any particular field under consideration for seed growing. n order to be entirely satisfied that an area offered for stock seed growing is free rom seeds likely to contaminate the seed crop, the soil must be sampled and the eed content examined by germinating seeds from such samples and growing the eedlings until the plants can be identified. According to the author, root crops n general supplied with generous quantities of organic manure appear to be most satisfactory as preparatory crops for grass-seed crops. The next section is devoted to field-management which covers a wide range of subjects and includes a description of methods and time of sowing, tilth, machinery employed for sowing and other operations, management in the seeding year, manures and fertilisers, grazing, stubble burning and roguing. There are two chief methods of sowing, (1) in drills and (2) in broadcast. The range of different dates for sowing different grasses and comparative value of nurse crops, including discussion on operations required in drill and broadcast stands under cover crops, are noted. Emphasis is laid on the need for working on the cleaning implements between the drills at frequent intervals during the seeding year in order to keep the weeds under control. Hand-hoeing is considered the most reliable method for relatively small areas of special stocks but this is found rather expensive for large areas. The comparative value of these as well as other methods employed for suppressing the weeds are described.

Grass species vary considerably in their need for fertilisers in relation to seed production. A full description of the comparative value of different fertilisers under different conditions is given. Unquestionably the master factor in any scheme of manuring grass for seed is nitrogen, whereas phosphates and potash are required to a much more limited extent. It is stated that in general terms it may be said that the more leafy the strain the higher should be the soil fertility. Of the species of grasses dealt with, the rye grasses are the most difficult as regards obtaining satisfactory seed yields from drills in successive years. Application of lime has been found to increase the longevity of such strains. The addition of farmyard manure seems to be indicated for the third seed crop at the latest, not only for plant nutrition but also to improve the mechanical condition of the land, water-holding capacity of lighter soils and drainage in the heavier soils. Broadcast areas of grasses grown for pure seed make greater demands on fertilisers than drill sowings of the same grasses. The proper times of operations like grazing

of grass seed islands, *stubble burning and roguing are given* Greater emphasis is laid on obtaining clean crops on the field than on expensive cleaning machinery capable of removing any and every sort of impurity from the seed An account of the indications of maturity of different grass species and strains suitable time of harvesting, harvesting machinery, field conditioning and stacking is given in the section on harvesting which follows next According to the author, ripening is delayed when the stand is poorly developed in the previous autumn and also by such factors as heavy soils and wet summers Post harvest treatments such as threshing, hulling, conditioning of the seed, seed cleaning and storing are described in a separate section The Station sends out a team of four men with a peripatetic thresher driven by an S H P Semi Diesel engine during the end of July or the first week of August to begin threshing the early seed crops harvested in different counties The thresher is constructed specially for the work of dealing with the pedigree stocks Moisture being responsible for deterioration of seed in store, attempts have been made to keep the moisture content below 14 per cent—a percentage which is considered safe for keeping the seed in bags A moisture-testing machine is used to determine almost instantaneously whether a threshed seed has sufficiently low moisture content to justify leaving it in bags after threshing Measures adopted to dry the seed and pests appearing in the stored grass seeds with methods to deal with them effectively are described The method of maintaining successive seed crops in good conditions is explained According to the author thorough cultivation, manuring and good management are essential to maintain seed productivity for a number of years An account of crops to follow the grass crop is also given Abandoned drills is the first problem which confronts *the seed growers and the methods to deal with the buried stubble* effectively are described The bulletin contains a brief statement of a new scheme for marketing seed of the strains bred at the station in which collaboration will be assured between the station on the one hand and the seed trade and the Growers' Association on the other, a complete scheme of inspection and certification will be incorporated The final section gives a list of the strains released by the station with a brief statement of the characteristics of each

The importance of this latest contribution to the knowledge of production of new grass seed and management of the grass land from the world known Welsh Station cannot be over estimated, especially in view of the wide spread interest which is being awakened in dairy farming and improving pastures in general in India Sir John Russell and Dr Wright both drew attention to the necessity of an increase in the amount of grass available and extended experimental work on management of grass land in their reports The Bulletin is thus a most welcome addition to the literature available on the subject and giving as it does the latest technique employed in growing grasses, will be found useful by those interested in the subject [R L S]

ollection of Native Grass Seed in the Great Plains, U. S. A. BY F. J. CRIDER, Head, Section Conservation Nurseries, Soil Conservation Service, U. S. Department of Agriculture, Washington, D.C., and M. M. HOOVER, In-charge, Grass Unit Conservation Nurseries, Soil Conservation Service, U. S. Department of Agriculture, Washington, D. C. (Herbage Publication Series Bulletin No. 24. Published by the Imperial Bureau of Plant Genetics, Herbage Plants, Aberystwyth, Great Britain, September 1937). Pp. 8+7 plates. Price 2*s*.

THIS paper gives an illustrated account of the typical grasses of the Great lains which are being collected in connection with the soil conservation pro-'amme. While all problems associated with the quantity collection of the native grass seed have not been satisfactorily solved, enough experience has been gained ınd sufficient progress has been made to furnish a practical basis for the collection of the major species. Most local species " shatter " soon after ripening, which nakes the period of harvest much shorter than that of cultivated grasses. This lifficulty is overcome in part by the use of special machinery capable of harvest-ng considerable quantities of seed in a short time. Most noteworthy of these levices is the power stripper which can harvest twenty-five to thirty acres per lay for each unit. These strippers because of their self-mobility and ease of ıeight adjustment are found to be the most practical type of equipment for this vork. In addition to the quantity collection of native seed, a number of nurseries ıave been established in the Great Plains for growing some of the more promising pecies and strains of both local and introduced plants for seed production. The eed and plant collectors are urged to keep constantly on the look-out for plants vhich may be an improvement over those now being used. This may include inds which, because of special properties such as soil binding, ground cover, drought esistance, simplicity of propagation or ease of harvesting, are especially valuable or use in wind or water erosion control. More than a thousand species and strains ıave been collected in this way some of which are promising. To supplement tatements given in the paper, photographs with descriptive information are ppended which clearly indicate the type of grasses and machinery employed for ıarvesting. The publication will be of particular interest to persons in the more rid grass land regions where erosion is a problem. [R. L. S.].

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omparative Tests on the Utility of Pneumatic-tyred and Steel-tyred Carts (Conducted at the University of Reading Farm, Sonning). BY J. B. PASSMORE AND M. H. R. SOPER. (Reprinted from the Bulletin of the Rubber Growers' Association, October 1937).

THE note records the results of the final test carried out at the University f Reading Farm at Sonning on the 13th April 1937. The chief feature of the

method adopted consisted of the application of a dynamometer for registering the reading of the average draught requirements of different carts Readings were taken over a distance of roughly 200 yards on a grass field and an unploughed field from which mangolds had been carted during the winter The results show that (1) roller bearings did not appear to make much difference and (2) that pneumatic tyres reduced the draught over soft ground sufficiently to give a considerable saving in horse power The note is illustrated, and in view of the fact that trials for testing the comparative merits of pneumatic tyred and iron or wooden tyred country carts are being carried out in India, the information will be found useful [R L S]

Agricultural Marketing in India. By B B Mukerjee, M.A, Department of Economics Patna College, Patna (Thacker Spink and Co, Ltd, Calcutta 1937) Pp 259, bibl 60 Price Rs 4 8 0

An attempt has been made in this book to offer a comprehensive study of the different aspects of marketing based on five years' personal investigations in the principal marketing centres of India The book covers a wide range of subjects extending over fourteen chapters and discusses almost all important aspects of marketing Various types of middlemen and their methods of working in different provinces are discussed in the first chapter The author shows how the cost of distribution can be reduced by organising different services and making them more direct A chapter is devoted to the description of markets in India Laws regulating the markets attempts made in recent years to improve them and the method of sale of different commodities in them are described Market finance is also discussed and an account of the short period loans and their sources which figure so prominently in the rural indebtedness in India is given The problem of marketing in India is all the more complicated owing to the bewildering diversity of the weights and measures used in different parts of the country The author gives a brief survey of the various weights and measures adopted in different parts and shows in a clear manner that orderly marketing is not possible without their standardisation A chapter is devoted to various methods of storing different commodities

The author has devoted a chapter to the question of adulteration carried out in different commodities Stress is laid on standardisation and grading Transportation by rail and road and its attendant difficulties form the subject matter of another chapter 'Futures' trading as is carried on in principal commodities in a few important markets is described An account of agricultural prices and the factors influencing them is given Stress is also laid on the employment of the co operative principle in the process of marketing A brief survey of some

f the leading co-operative organisations in India is made and measures on which he success of co-operative marketing depends are described. Examples of successful attempts made in some places to link up producers and consumers—so often set against one another in sharp conflict—in a harmonious relationship calculated to promote the interests of both are given. The relationship of the State to marketing is discussed in another chapter and an account of the relative merits of different measures adopted in other countries for helping the agriculturists is given. In the end, a brief survey of the measures adopted by the Government of India in the direction of improvement of marketing is made.

The improvement of marketing organisation is very essential for the amelioration of the economic conditions in which agricultural produce is marketed in different parts of the country. Extracts from various reports of the Chambers of Commerce and registered trade associations are also given. The book will thus be found useful by those who are interested in the subject. [R. L. S.].

A Review of the Literature on Stock-scion Incompatibility in Fruit Trees, with particular reference to Pome and Stone Fruits. By G. K. Argles (Foreword by Prof. V. H. Blackman, Sc.D., F.R.S.). (Technical Communication No. 9 of the Imperial Bureau of Fruit Production, East Malling, Kent, England, 1937). Pp. 115, bibl. 194. Price *5s.*

The problem of incompatibility has loomed ever larger with the increasing realization of the advantages to be gained by the use of tested clonal rootstocks for the production of uniformly excellent fruit.

The literature on the subject is considerable, but it is scattered over very many journals, bulletins and books, and is not always easy to follow. In it the term "incompatibility" is used extremely loosely and may mean much or little. The author here briefly summarizes the phenomena which occur as the result of slight or pronounced incompatibility in different stock-scion combinations.

The horticulturist is often faced with the problem of growing varieties of fruit in localities where there is no experience to guide him. If he knows that under certain conditions, which may in some respects resemble his own, certain rootstocks have given promising results with particular varieties, at least he has something on which to base his trials. He would be most unfortunate if, as regards the common deciduous tree fruits of commerce, he did not find some guidance in these pages.

The physiologist, moreover, has in this common feature of practical horticultural practice a unique investigational field at his disposal. The author gives him a firm basis on which to work.

First the manifestations or symptoms of incompatibility in fruit trees are considered and their possible causes discussed Next the compatibility or incompatibility shown by individual varieties of common diciduous fruit trees in respect of particular rootstocks is noted considerable attention being paid to the practical field experience of research workers in different parts of the world with particular scions and rootstocks

Certain general conclusions are drawn with regard to both the symptoms and the cause of inherent incompatibility and tentative suggestions are made for drawing up a research programme to investigate the problem

In an appendix covering forty pages are tabulated the many and often contradictory records of compatibility and incompatibility between particular rootstocks and particular varieties They should prove helpful not only to the physiological invest gator but also to the practical horticulturist

NEW BOOKS

On Agriculture and Allied Subjects

Manual of the Grasses of the West Indies. By A. S. Hitchcock, Misc. Pub. No. 243, U. S. Dept. Agric., Washington, 1936, pp. 439.

The Biological Control of an Insect in Fiji—an account of the coconut leaf-mining beetle and its parasite complex. By T. H. C. Taylor, M.Sc. (Lond.) Royal 8vo, pp. x and 239, with 23 plates, 2 maps, and 17 text figures. (The Imperial Institute of Entomology, 41, Queen's Gate London, S. W. 7) 1937.

Bound in cloth price 12*s*. net. Postage inland 6*d*., abroad 10*d*.

Cacti—A Gardener's Handbook for their Identification and Cultivation. By J. Borg, M.A. M.D., late Professor of Natural History in Malta University. (MacMillan and Co., Ltd., London, W. C. 2.) 21*s*. net.

Principles and Methods of Tree-Ring Analysis. Pub. No. 486. By Waldo S. Glock with a foreword by A. E. Douglass and a contribution by G. A. Pearson. (Carnegie Institution of Washington, Washington, D. C.) Price \$2·00 in paper, \$2·50 in cloth.

Methods in Plant Physiology—A Laboratory Manual and Research Handbook. By Walter E. Loomis, Ph.D., Associate Professor of Plant Physiology and Research Associate, Iowa State College, and Charles A. Shull, Professor of Plant Physiology, University of Chicago, with a chapter on statistical methods by George W. Snedecor, M. S., Professor of Mathematics and Director of the Statistical Laboratory, Iowa State College. 472 pages, 94 illustrations, (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W. C. 2.) 25/- net.

Phytohormones. By F. W. Went, Ph.D., Professor of Plant Physiology, California Institute of Technology and K. V. Thimann, Ph.D., Assistant Professor of Plant Physiology, Harvard University. (MacMillan and Co., Ltd., London, W. C. 2.) 17*s*. net.

Climate: A Treatise on the Principles of Weather and Climate. By W. G. Kendrew. (Oxford University Press Amen House, Warwick Square, London, E. C. 4.) Second Edition, 15*s*. net. (provisional).

A Guide to Veterinary Parasitology for Veterinary Students and Practitioners. By T. Southwell, D.Sc., Ph.D., and A. Kirshner, M.B., Ch.B., D.T.M. (London: H. K. Lewis & Co., Ltd.) Price 7*s*. 6*d*. net.

Malkmus Clinical Diagnosis of the Internal Diseases of Domestic Animals English Translation revised by J R Mohler, V M D D Sc and Adolf Eichorn D V S (Baillière Tindall and Cox, London W C 2) Price 15s

Veterinary Pharmacology—Materia Medica and Therapeutics By Prof Howard Jey Milks D V S (Bailliere Tindall & Cox London W C 2) Price 30s

A History of Pharmacy By James Grier M Sc Ph D, formerly Senior Lecturer in Pharmacy Victoria University of Manchester (London Pharmaceutical Press 1937) Price *6s*

The Digestive Tract By A E Barclay (Cambridge University Press) *36s* net

The Genetics of Sexuality in Animals By F A E Crew (Cambridge University Press) *10s 6d* net

The Intelligence of Animals By G C Grindley M A, B Sc (Methuen 6 Essex Street London W C 2) *2s 6d* net

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

BRITISH INDIA

Notification No. F. 46-11/38-A., dated the 17th March 1938, issued by the Government of India in the Department of Education, Health and Lands.

In modification of this Department Notification No. F. 116-34-A., dated the 8th April 1937, it is notified for general information that no fee will be charged for consignments of plants and fruits intended for export to countries abroad when the work of inspection and certification is done at Karachi by an officer stationed at that place. A fee of Rs. 20 will be charged for each consignment only when an officer has to be called from outside Karachi to make the examination.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

His Excellency the Governor General in Council has been pleased to appoint the Hon'ble Minister in charge of the Portfolio of Agriculture under the Government of Sind, to be a member of the Imperial Council of Agricultural Research and of its Governing Body

Mr L Mason, C I E, O B E, M C, Inspector General of Forests has been nominated by the Central Government to be the representative of the Forest Research Institute Dehra Dun, on the Imperial Council of Agricultural Research with effect from the 1st December 1937, *vice* Sir Gerald Trevor, C I E, resigned

The services of Mr F Ware, C I E, F R C V S, I V S, Director, Imperial Veterinary Research Institute are placed at the disposal of the Imperial Council of Agricultural Research with effect from the 7th May 1938

The Government of the Punjab have nominated Captain U W F Walker M C, M R C V S I V S, Director, Veterinary Services, Punjab, as the representative of the Punjab Veterinary Department on the Council, with effect from the 14th February 1938, *vice* Mr T F Quirke, M R C V S, I V S, deceased

Indian Central Cotton Committee

The Governor General in Council has been pleased to appoint the Economic Botanist (Cotton) to the Government of the United, Provinces to be a member of the Indian Central Cotton Committee, with effect from the 16th November 1937 to the 30th September 1938

Mr M S Durutti (of Messrs Ralli Brothers Limited Bombay) has been nominated by the Bombay Chamber of Commerce to be a member of the Indian Central Cotton Committee, Bombay, *vice* Mr S B Samoilys, resigned

Mr J C McDougall, M A B Sc, I A S, Director of Agriculture Central Provinces and Berar, has been nominated by the Central Government to be a

member of the Indian Central Cotton Committee, to represent the Agricultural Department of that province, *vice* MR. R. H. HILL, M.A., resigned.

Indian Central Jute Committee

MR. G. C. LIMBOUSSI (of Messrs. Ralli Brothers, Limited) has been nominated by the Calcutta Baled Jute Association to be a member of the Indian Central Jute Committee, *vice* MR. EUTHYMOPULO, resigned.

MR. P. S. MACDONALD (of Messrs. Thomas Duff & Co., Ltd.) has been nominated by the Indian Jute Mills Association, Calcutta, to be a member of the Indian Central Jute Committee *vice* MR. G. M. GARRIE, resigned.

Indian Lac Cess Committee

The Governor-General in Council has been pleased to appoint MR. L. MASON, C.I.E., O.B.E., M.C., Inspector-General of Forests as a member of the Advisory Board of the Indian Lac Cess Committee, *vice* SIR GERALD TREVOR, C.I.E., resigned.

The Central Government have been pleased to appoint MR. W. F. DINES, (of Messrs. Angelo Brothers, Ltd.) nominated by the Bengal Chamber of Commerce, to represent the Shellac Manufacturing industry, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* MR. J. P. YOUNG, resigned.

Madras

MR. A. C. EDMONDS, B.A., Dip. Agri. (Cantab.), Deputy Director of Agriculture, III Circle, Bellary, has been granted leave, out of India, on average pay for four months and twenty-nine days and in continuation thereof, leave on half average pay for six months and twelve days, with effect from the 6th April 1938 or date of relief.

Bombay

RAO SAHIB B. P. VAGHOLKAR, Principal Agricultural Officer, Sugarcane Research Scheme, Padegaon, has been granted leave on average pay for four months with effect from the 15th February 1938, or the subsequent date on which he may be relieved.

Bengal

MR P J KERR, M R C V S, I V S, Veterinary Adviser to the Government of Bengal has been granted leave for eight months with effect from the 22nd March 1938 or any subsequent date on which he may avail himself of it

United Provinces

On return from leave MR T J EGAN, M R C V S, I V S, has been posted to be the Director of Veterinary Services, United Provinces, with effect from the 11th November 1937

Punjab

THE Punjab Government record with deep regret the death of MR THOMAS FRANCIS QUIRKE Director, Veterinary Services, Punjab

MR QUIRKE was born in June 1891, at Tipperary, Ireland After a preliminary education at Clongowes Wood College, Sallins, from 1905 to 1909, he entered the Royal Veterinary College, Ballsbridge, Dublin, and received his diploma of M R C V S in 1913 He was employed in veterinary work in Ireland for two years, and came to India in February 1915, having been appointed to the Indian Civil Veterinary Department now known as the Indian Veterinary Service He served for some five years as a Superintendent in this Department at Ferozepore and Rawalpindi In March, 1920 he was promoted to the post of Chief Superintendent in succession to the late LT COL FARMER He became a specialist in the control of contagious diseases and in animal husbandry In 1928, when the Veterinary Department was separated from the Agricultural Department, he was appointed Director of the new Department and continued to hold this post until his death on January 13, 1938 He has thus been at the head of the veterinary work of the province for nearly eighteen years During this period the veterinary Department of the Punjab has attained a growth and a fame unparalleled in India, and the Punjab Government gratefully acknowledge how large a share of this success was due to MR QUIRKE's unstinting efforts, wide knowledge and unfailing enthusiasm MR QUIRKE was keenly interested in horse breeding and did much to encourage it both in his official capacity and through his long connection with the Lahore Race Club His early death has deprived the province of a sympathetic and experienced officer whose memory will be preserved in the enduring work which he did for the people of the province Government deeply regret his loss and they and all with whom he worked no less than his many personal friends, will long remember him with affection

CAPTAIN U. W. F. WALKER, M.C., M.R.C.V.S., I.V.S., officiating Principal, Punjab Veterinary College, Lahore, has been appointed provisionally Director, Veterinary Services, Punjab, with effect from the 14th January 1938 *vice* MR. T. F. QUIRKE, M.R.C.V.S., I.V.S., deceased. CAPTAIN WALKER will continue to perform the duties of the post of the Principal, Punjab Veterinary College, in addition to his duties as Director, Veterinary Services, until further orders.

KHAN BAHADUR M. AFZAL HUSAIN, M.Sc., M.A. (Cantab.), I.A.S., Principal, Punjab Agricultural College and Entomologist to Government. Punjab, Lyallpur, has been granted leave on average pay for two months and twenty-one days with effect from the 20th January 1938, afternoon.

DR. P. E. LANDER, M.A. (Cantab.), D.Sc. (Lond.), F.I.C., I.A.S., Agricultural Chemist to Government Punjab, Lyallpur, has been appointed Principal, Punjab Agricultural College, Lyallpur, with effect from the 20th January 1938. afternoon *vice* KHAN BAHADUR M. AFZAL HUSAIN, granted leave.

DR. R. L. CHOPRA, M.A., Ph.D. (Wales), Assistant to the Entomologist, Lyallpur, has been appointed Entomologist to Government, Punjab, Lyallpur, with effect from the 20th January 1938 *vice* KHAN BAHADUR M. AFZAL HUSAIN, granted leave and in addition to his own duties.

Central Provinces and Berar

On return from leave, MR. J. C. MACDOUGALL, M.A., B.Sc., has been reposted as Director of Agriculture, Central Provinces and Berar.

On relief by MR. J. C. MACDOUGALL, MR. R. H. HILL, M.A. (Cantab.). officiating Director of Agriculture, Central Provinces and Berar, reverts to his substantive post of Deputy Director of Agriculture, Economics and Marketing, Central Provinces and Berar.

On relief by MR. R. H. HILL, M.A. (Cantab.), MR. P. D. NAIR, M.A., L.Ag. (Hons.) Post-Graduate, officiating Deputy Director of Agriculture, Economics and Marketing, Central Provinces and Berar, reverts to his substantive appointment as Assistant Director of Agriculture and will remain attached to the office of the Director of Agriculture, Central Provinces and Berar.

Assam

MR FAZLUL HAQUE, Dip Agri, Deputy Director of Agriculture, Upper Assam Valley, has been appointed to hold the temporary post of Deputy Director of Agriculture, Reconstruction, Assam, with effect from the 12th November 1937

DR H K NANDI, Ph.D, has been appointed on probation to the post of Economic Botanist Assam in class I of the Assam Agricultural Service with effect from the date on which he assumes charge of his duties

Orissa

MR P D DIXIT, M Sc, First Research Assistant in the Rice Research Scheme for Orissa has been appointed temporarily as Paddy Specialist in the scheme

BURMA

CAPTAIN S R RIPPON, M R C V S, officiating Director of Veterinary Services has been granted leave on average pay for one month and ten days combined with study leave in Africa for six months, with effect from the 1st March 1938 or the subsequent date on which he avails himself of it

CAPTAIN S R RIPPON, M R C V S, and MR D T MITCHELL, M R C V S respectively, made over, and received, charge of the duties of the Director of Veterinary Services Burma, on the 8th February, 1938

U NYAN KYAW G B V C, Veterinary Superintendent, and CAPTAIN S R RIPPON, M R C V S respectively made over and received charge of the duties of Deputy Director of Veterinary Services, Lower Burma Charge, Insein, on the 9th February 1938

U NYAN KYAW, G B V C, Veterinary Superintendent, has been appointed temporarily to be Deputy Director of Veterinary Services, Lower Burma Charge, with headquarters at Insein, in addition to his own duties, as Veterinary Superintendent in charge of South Central Circle, in place of CAPTAIN S R RIPPON proceeding on leave

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	*d.*
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	*d.*
Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
,, 1934-35	0	6
,, 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

	s.	*d.*
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

Indexing Publication s. d.

Index Veterinarius.—Four issues a year. First issue, April 1933. Annual Subscription (postage paid) Volumes I to III mimeographed, Volume IV onwards printed 100 0

III OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL NUTRITION, ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEEN

Journal

Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—

Subscription per volume of 4 numbers 42 0

Per single number 13 0

Occasional Papers

Technical Communications—

6 The Composition of Certain African Foods and Feeding Stuffs . . 1 0

7 Wheat Pre eminence as a Cereal Food : Nutritive Value , Relation to Health and Disease. 1 0

Occasional Communications—

1 The Effect of Climate on the Composition of Pasture Plants . .

IV. OBTAINABLE FROM THE IMPERIAL BUREAU OF PLANT BREEDING AND GENETICS PLANT BREEDING INSTITUTE, SCHOOL OF AGRICULTURE, CAMBRIDGE

Journal

Plant Breeding Abstracts—

Quarterly Annual subscription 15 0

Single copy 5 0

Occasional Papers

Indexes to Plant Breeding Abstracts—

Subject Index to Vols I to V of Plant Breeding Abstracts . . . 5 0

Subject Index to Vol. VI of Plant Breeding Abstract 2 6

Supplements to Plant Breeding Abstracts—

Summary of Reports received from Countries exclusive of the British Empire, 1928-31 Supplement I 0 6

Summary of Reports received from Stations in the British Empire, 1932-35 Supplement II 5 0

Technical Communications—

Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics) 10 0

The South American Potatoes and their Breeding Value . . . 3 6

Bibliographical Monographs—

Breeding Resistant Varieties, 1930 33 (Supplement) 2 0

The Experimental Production of Haploids and Polyploids . 5 0

OBTAINABLE FROM THE IMPERIAL BUREAU OF PASTURES AND FORAGE CROPS WELSH PLANT BREEDING STATION, AGRICULTURAL BUILDINGS, ALEXANDRA ROAD ABERYSTWYTH, WALES

Journals

	s.	d.
Ierbage Abstracts—		
Quarterly. Annual subscription	15	0
Single number	5	0
Ierbage Reviews—		
Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in that to Herbage Abstracts.		

Occasional Papers

ulletins—		
18. Pastures and Forage Crops in South Africa	3	0
19. Production of Grass Seed	5	0
20. Insects and other Pests Injurious to the Production of Seed in Herbage and Forage Crops	2	6
21. The Influence of Climatic Conditions on Type Composition	1	0
22. Technique of Grass Seed Production at the Welsh Plant Breeding Station	5	0
23. Production of Legume Seed	5	0
24. Collection of Native Grass Seed in the Great Plains, U. S. A.	2	0

'I. OBTAINABLE FROM THE IMPERIAL BUREAU OF HORTICULTURE AND PLANTATION CROPS, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

Journal

Iorticultural Abstracts—		
A quarterly abstract publication of current horticultural literature—		
Annual subscription	15	0
Single copy	4	0

Technical Communications

7. Vegetative Propagation of Tropical and Sub-tropical Fruits, 1936. J. St. Clair Feilden and R. J. Garner	2	0
8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R. M. Greenslade	2	6

Occasional Papers

3. Annotated Bibliography on Bitter-Pit, 1934	1	6
4. Recent Work of Tropical and Sub-Tropical Interest	0	6

o

s. d.

Other Publications—

Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933 Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science.* Available from the Bureau 5 0

Old and New Standpoints on Senile Degeneration, 1931. A. P. C Bijhouwer 0 5

Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton Being unnumbered Empire Marketing Board Publication. (Free).

Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11 . . . . 1 0

VII Obtainable from the Imperial Bureau of Animal Breeding and Genetics Institute of Animal Genetics, University of Edinburgh, King's Buildings West Mains Road, Edinburgh

Journal

Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription 15 0

Occasional Papers

Bibliography of the Works of J C Ewart (free to subscribers of Animal Breeding Abstracts, Vol 1), 1934 . . . . 0 6

Animal Breeding in the British Empire A Survey of Research and Experiment, 1934 . . . . 2 0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology (Helminthology), Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St Albans, Herts

Journal

Bibliography of Helminthology. For the year 1933—

Library Edition, bound in cloth 10 6

Stiff paper cover only 8 0

Helminthological Abstracts (1932 onwards). Issued in five or six parts per volume, each volume covering the literature of a single year. Subscription per volume, payable in advance 30 0

Completed volumes, bound in cloth 32 0

Occasional Papers

(i) The Effects of some Natural Factors on the Second Ecdysis of Nematode Infective Larvae G. Lapage 4 0

Notes and Memoranda—

No. 11. Recent Developments in the Control of *Heterodera marioni* . . 1 6

rBLICATIONS ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY, 41 QUEEN'S GATE LONDON S. W. 7

	s. d.
.lletin of Entomological Research—	
Published quarterly, and containing original articles on Economic Entomology. Issued post free.	
Annual subscription (payable in advance)	30 0
)view of Applied Entomology—	
Consisting of abstracts or reviews of all current literature on Economic Entomology throughout the world. Published monthly in two series—	
Series 'A' dealing with insect and other arthroped pests of cultivated plants, forest trees and stored products of animal and vegetable origin.	
Series 'B' dealing with insects, ticks, etc., conveying disease or otherwise injurious to man and animals. Issued post free.	

	Series 'A'	Series 'B'
Annual subscription (payable in advance)	30s.	15s.
Vol. XXIII (1935)	42s.	21s.

	s. d.
oological Record—Part Insecta—	
Published annually about July in each year and containing as complete a record as possible of the literature of the previous year, chiefly from the systematic standpoint.	
Annual subscription (including postage)	15 6
eport of the Fourth Imperial Entomological Conference, 19th—27th September, 1935	4 0

UBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGICAL INSTITUTE, KEW, SURREY

Journal

eview of Applied Mycology—	
Annual subscription, 12 monthly parts, with title-page and index (post free)	
Single part	2 0
Title-page and index	3 0
eport on the Third Imperial Mycological Conference, 1934 . .	2 0

List of Agricultural Publications in India from 1st August 1937 to 31st January 1938

Title	Author	Where published
GENERAL AGRICULTURE		
Agriculture and Live stock in India, Vol VII, Parts 5 and 6 and Vol VIII, Part 1 Annual subscription Rs 6 or 9 *s* 9*d* (A bi monthly Journal of agriculture and animal husbandry for the general reader interested in agriculture or live stock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi
The Madras Agricultural Journal Monthly Annual subscription Rs 4	K Ramiah (Editor) Published by the M A S Union, Agricultural Research Institute, Coimbatore	The Secretary, M A S Union Agricultural College Lawley Road, P O
The Journal of the Trichinopoly District Agricultural Association (English and Tamil) Quarterly Annual subscription Re 1 8 0 for non members, free for members	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post	The Secretary The Trichinopoly District Agricultural Association, Teppakulam Post
The Journal of the Mysore Agricultural and Experimental Union (English) Quarterly Price As 13 or 1 *s* 3 *d* per copy	Dr V K Badami (Chief Editor)	The Secretary the Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore
Mysore Vyavasaya Shodhaka Sanghada Patrike (Monthly) Price As 4 per copy	N Vankatasubbaiya (Chief Editor)	Ditto
The Poona Agricultural College Magazine Quarterly Annual subscription Rs 2 8 0	V G Deshpande and S M Rao, (Editors)	The Editor, *Poona Agricultural College Magazine*, Poona
Shetki Shetkari (Marathi) Monthly Annual subscription Re 1 3 0	Vasudev Ganesh Pande	The Editor, *Shetki Shetkari*, Agricultural College, Poona
The Planters' Journal and Agriculturist Fortnightly Annual subscription Rs 10 or 16 *s*	Theo H Thorne (Editor)	The Manager, *The Planters' Journal and Agriculturist*, 13 Ezra Mansions Calcutta
Krishi-sampad (Bengali) Monthly Annual subscription Rs 3	N K Ghosh (Editor)	The Manager, *Krishi Sampad* Office, Dacca

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
ie Mufidul Mazarin (Urdu) Annual subscription Re. 1 for subscribers in United Provinces and Re. 1-8-0 for subscribers outside the province	C. C. Sanyal, (*Editor*) Government Agricultural Journals	Office of the Editor, Government Agricultural Journals, Sikandar-Bagh, Lucknow
he Kisan Upkarak (Hindi). Annual subscription Re. 1 for subscribers in United Provinces and Re. 1-8-0 for subscribers outside the province	Ditto	Ditto
he Allahabad Farmer. Bi-monthly. Annual subscription in India Rs. 2	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad	The Allahabad Agricultural Institute, United Provinces (American Presbyterian Mission), Allahabad
easonal Notes. Price As. 4 per copy	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
he Nagpur Agricultural College Magazine. Quarterly. Annual subscription Rs. 3	Published by P. D. Nair, Agricultural College, Nagpur	The Editor, *The Nagpur Agricultural College Magazine*, College of Agriculture, Nagpur
isan (Hindi). Quarterly. Annual *subscription Rs. 2. As. 8 per copy*	Issued by the Agricultural *Association, Bihar and* Orissa	B. N. Sircar, Senior Mar*keting Officer and Edi*tor. *Kisan*, Patna
griculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10-0 or 7 *s.* 9 *d.*	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi
Report of the Work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India. Price Rs. 1-14-0 or 3 *s.* 3 *d.*	Sir John Russell, D.Sc., F.R.S.	Ditto
Report on the Cold Storage and Transport of Perishable Produce in Delhi. Price As. 12 or 1 *s.* 3 *d.*	Agricultural Marketing Adviser to the Government of India	Ditto
Summary Proceedings of the 34th Meeting of the Indian Central Cotton Committee. Price Re. 1	Issued by the Publicity Officer, Indian Central Cotton Committee, Bombay	Indian Central Cotton Committee, Bombay
Garrowhill Cotton and the Central Provinces Cotton Control Act Prohibiting its Cultivation. (English, Hindi and Marathi). *Gratis*	Ditto	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Cholam Malt (English, Tamil and Telugu) (Reprint) Leaflet No 4 of the Department of Agriculture, Madras	M Suryanarayana	Government Press, Madras
Care and Management of Cattle manure in South India (English, Telugu, Tamil, Kanarese and Malayalam) (Reprint) Leaflet No 24 of the Department of Agriculture, Madras	V Muthuswamy Ayyar	Ditto
The Earth Scoop (Telugu, Tamil, Kanarese and Malayalam) Leaflet No 78 of the Department of Agriculture, Madras	N G Charley . .	Ditto
Improved Turmeric Polisher (Tamil, Telugu, Kanarese and Malayalam) Leaflet No 80 of the Department of Agriculture, Madras	Ditto	Ditto
Manufacture of Active Carbon from Paddy Husk (English, Telugu, Tamil Kanarese and Malayalam) Leaflet No 81 of the Department of Agriculture, Madras	P V Ramiah . .	Ditto
Evils of Damping Groundnut (English, Telugu, Tamil, Kanarese and Malayalam) Leaflet No 83 of the Department of Agriculture, Madras	J S Patel . .	Ditto
Note on Nilgiri Agriculture (Kanarese) Pamphlet No 10 of the Department of Agriculture, Madras	D G Munro . .	Ditto
A H 25 Improved Groundnut (English) Pamphlet No 12 of the Department of Agriculture, Madras	J. S Patel . . .	Ditto
Plough Early (English) (Reprinted) Broad Hint No 3 of the Department of Agriculture, Madras	Rao Bahadur D Ananda Rao	Ditto

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
Plough Efficiently (English). (Reprinted). Broad Hint No. 4 of the Department of Agriculture, Madras	Rao Bahadur D. Ananda Rao	Government Press Madras
Sow Good Seed (English). (Reprinted). Broad Hint No. 5 of the Department of Agriculture, Madras	G. R. Hilson . .	Ditto
Beware of Weeds (English). (Reprinted). *Broad Hint No. 6 of the Department* of Agriculture, Madras	Ditto . . .	Ditto
Annual Report of the Department of Agriculture, Bengal for 1936-37. Part I, price As. 8; Part II price Re. 1-4-0	Issued by the Department of Agriculture, Bengal	Superintendent, Government Printing, Bengal
A Short Survey of the Work, Achievements and Needs of the Bengal Agricultural Department for the period 1906-1936. Free (For official use only)	Ditto .	Office of the Director of Agriculture, Bengal, Dacca
Instructions for Sowing Improved Varieties of Rice Seed (Reprinted). Leaflet No. 36 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Rai Bahadur R. L. Sethi	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Eastern Circle, Partabgarh 3. Deputy Director of Agriculture, Western Circle, Aligarh 4. Deputy Director of Agriculture, North Eastern Circle, Gorakhpur 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
The Utilization of Molasses as a Manure (Urdu and Hindi). Leaflet No. 41 of the Department of Agriculture, United Provinces, (Free in U. P. only)	Department of Agriculture, United Provinces	Ditto
Lawn Making (Urdu). Leaflet No. 48 of the Department of Agriculture, United Provinces, (Free in U. P. only.)	Ditto	Ditto
Seed Sowing (Urdu). Leaflet No. 49 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Ditto.	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd*		
Hedges (Urdu) Leaflet No 50 of the Department of Agriculture United Provinces (Free in U P only)	Department of Agriculture United Provinces	1 Deputy Director of Agriculture Sarda Circle Lucknow 2 Deputy Director of Agriculture Eastern Circle Partabgarh 3 Deputy Director of Agriculture, Western Circle Aligarh 4 Deputy Director of Agriculture North Eastern Circle Gorakhpur 5 Deputy Director of Agriculture Bundelkhand Circle Jhansi 6 Deputy Director of Agriculture Rohilkhand and Kumaun Circle Bareilly
Rose Cultivation (Urdu) Leaflet No 51 of the Department of Agriculture United Provinces (Free in U P only)	Ditto	Ditto
Other Important Matters about Seeds (Urdu) Leaflet No 52 of the Department of Agriculture United Provinces (Free in U P only)	Ditto	Ditto
Paddy Cultivation in Canal Tracts (English) Leaflet No 66 of the Department of Agriculture United Provinces (Free in U P only)	Ditto	Ditto
The Cultivation of *Ajwain* (English) Leaflet No 67 of the Department of Agriculture United Provinces (Free in U P only)	Ditto	Ditto
Cultivation of Some Important Drugs in the Punjab Price As 10	Issued by the Department of Agriculture, Punjab	Superintendent Government Printing Punjab, Lahore
L S S A New Cotton of Hirsutum Type Leaflet No 130 of the Department of Agriculture Punjab Free	Ditto	Ditto
Annual Report of the Department of Agriculture Bihar for the year 1936 37 (In the press)	Issued by the Department of Agriculture, Bihar	Government Printing Bihar, Gulzarbagh
Annual Report of Tirhut Range Bulletin No 2 of 1937 of the Department of Agriculture Bihar	Ditto	Ditto

Title	Author	Where published

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
›nual Report of Patna Range. Bulletin No. 4 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture Bihar	Government Printing, Bihar, Gulzarbagh
›nual Report of Bhagalpur Range. Bulletin No. 5 of 1937 of the Department of Agriculture, Bihar	Ditto	Ditto
›nual Report of Chota Nagpur Range (In press). Bulletin No. 6 of 1937 of the Department of Agriculture, Bihar	Ditto	Ditto
›nual Report of the Engineering Sections. Bulletin No. 9 of 1937 of the Department of Agriculture, Bihar	Ditto	Ditto
›oya Bean—Its Cultivation and Use. Leaflet No. 5 of 1937 of the Department of Agriculture, Bihar	Ditto	Ditto
›eport on Demonstration Work carried out in Northern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Issued by the Department of Agriculture, Central Provinces and Berar	Government Printing, Central Provinces and Berar, Nagpur
Report on Demonstration Work carried out in the Eastern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Ditto	Ditto
Report on Demonstration Work carried out in the Western Circle together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Ditto	Ditto
Report on Demonstration Work carried out in the Southern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Ditto	Ditto
Demonstration Plot, Kham. (English, Hindi, and Marathi). Leaflet No. 15 of 1937 of the Department of Agriculture, Central Provinces and Berar. (Free)	Ditto	

Title	Author	Where published

GENERAL AGRICULTURE—*concld*

Eradication of *Kans* by Cultivated Fallow System (English Hindi and Marathi) Leaflet No 16 of 1937 of the Department of Agriculture Central Provinces and Berar Free	Issued by the Department of Agriculture Central Provinces and Berar	Government Printing Central Provinces and Berar, Nagpur
Eradication of *kans kunda dub* and *nagarmotha* (English) Leaflet No 17 of 1937 of the Department of Agriculture, Central Provinces and Berar Free	Ditto	Ditto
Catch Crop for Orissa (Oriya) Bulletin No 8 of 1937 of the Department of Agriculture Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Annual Experimental and Research Report of Hyderabad Deccan for 1344 Fasli	Issued by the Department of Agriculture, Hyderabad Deccan	Government Central Press Hyderabad Deccan
Annual Administration Report of the Department of Agriculture Mysore for 1935 36 Price Rs 1 8 0	Issued under the authority of the Department of Agriculture, Mysore	Department of Agriculture Mysore, Bangalore
Soil Erosion	R Madhavan Pillai	Government Press Travancore
Castor Cultivation *Kasti Arandi* Price As 1	Dr J K Dubey	Government Press Bhopal

AGRICULTURAL STATISTICS

Supply and Distribution of Various Types of Indian Cotton during the Season of 1935 36 Statistical Bulletin No 6 (1935 36) Price As 8	Issued by the Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay
Stocks of Indian Cotton held in India by the Mills and the Trade on 31st August 1937 Statistical Leaflet No 2 (Fourth issue 1936 37) Price one anna	Ditto	Ditto
Receipts at Mills in India of Raw Cotton classified by Varieties 1936 37 Season Statistical Leaflet No 3 (Fourth issue 1936 37) Price one anna	Ditto	Ditto
Exports by sea of Indian Raw Cotton classified by Varieties 1936 37 Season Statistical Leaflet No 4 (Fourth issue 1936 37) Price one anna	Ditto	Ditto

AGRICULTURAL STATISTICS—*contd.*

Title	Author	Where published
eason and Crop Report of the Punjab for the year 1936-37	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
Season and Crop Report, Sind, for 1936-37. (In press)	Issued by the Department of Agriculture, Sind	The Daily Gazette Press Ltd., Karachi

SUGAR RESEARCH

Title	Author	Where published
Cultivation of Sugarcane in Tanjore Delta. Leaflet No. 82 of the Department of Agriculture, Madras	M. Anandan . .	Government Press, Madras
The Open Pan System of White Sugar Manufacture in Factories Completely Installed with Machinery Designed by the Bengal Department of Agriculture. Bulletin No. 1 of 1937 of the Department of Agriculture, Bengal. *Gratis*	Issued by the Department of Agriculture, Bengal	Office of the Director of Agriculture, Bengal, Dacca
Improved Methods of Cane Cultivation in the United Provinces. Bulletin No. 72 of the Department of Agriculture, United Provinces. Price Re. 1-8-0	Rai Bahadur R. L. Sethi, and others	Superintendent, Printing and Stationery, United Provinces, Allahabad
General Information about the Sugarcane Crop in the United Provinces (Urdu and Hindi). Leaflet No. 37 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Eastern Circle, Partabgarh 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Improved Methods of Cultivation and other Important Cultural Operations of Sugarcane (Urdu). Leaflet No. 38 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	Ditto

Title	Author	Where published

SUGAR RESEARCH—*contd.*

Title	Author	Where published
Irrigation of Sugarcane Crop (Hindi and Urdu) Leaflet No 33 of the Department of Agriculture United Provinces. Free in U P only	Issued by the Department of Agriculture, United Provinces	1 Deputy Director of Agriculture Sarda Circle, Lucknow 2 Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Eastern Circle, Partabgarh 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 5 Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6 Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Manuring of Sugarcane Crop in the United Provinces (Hindi and Urdu) Leaflet No 40 of the Department of Agriculture, United Provinces. Free in U P only	Ditto	Ditto
Ratooning of Sugarcane (Urdu) Leaflet No 42 of the Department of Agriculture United Provinces Free in U. P. only	Ditto .	Ditto
Open Pan Boiling for *gur* and Sugar Manufacture (Urdu) Leaflet No 43 of the Department of Agriculture, United Provinces. Free in U P only	Ditto .	Ditto
Manufacture of *Khandsari* Sugar as a Cottage Industry in Bihar (In press) Bulletin No 2 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
Work Done on Sugarcane in Orissa (English) Bulletin No 11 of 1937 of the Department of Agriculture, Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Sugarcane Cultivation and Sugar Industry	V Narayanan Nair	Government Press, Travancore

Title	Author	Where published
COTTON TECHNOLOGY		
Technological Reports on Trade Varieties of Indian Cottons, 1937. (Technological Bulletin Series A). Price Re. 1-8-0	Dr. Nazir Ahmad . .	Indian Central Cotton Committee, Vulcan House, Nicol Road, Ballard Estate, Fort, Bombay
Technological Reports on Standard Indian Cottons, 1937. (Technological Bulletin Series A). Price Re. 1-8-0	Ditto .	Ditto
The Effect of Different Degrees of Compression on the Fibre Properties and Spinning Quality of Indian Cottons. (Technological Bulletin Series A). Price As. 8	Ditto .	Ditto
Spinning Tests on Punjab-American 4F Cotton with Different Schemes of Drafts in the Speed Frames. (Technological Bulletin Series A). Price As. 8	Ditto .	Ditto
A Device for Determining the Proportion of Fibres of Different Lengths in a Sample of Cotton. (Technological Bulletin Series B). Price As. 8	Ditto .	Ditto
Studies in the Variation of Strength and Weight per Inch with Group Length of Cotton Fibres. (Technological Bulletin Series B). Price As. 8	Ditto .	Ditto
Spinning Test Report on Samples of Latur Cotton, 1936-37. (Technological Circular No. 882). Price As. 4	Ditto .	Ditto
Spinning Test Report on Samples of Bengal Cotton, 1937-38. (Technological Circular No. 912). Price As. 4	Ditto .	Ditto
Spinning Test Report on Samples of Moglai Cotton, 1937-38. (Technological Circular No. 913). Price As. 4	Ditto .	Ditto
Technological Report on Verum (Nagpur) 1937-38. (Technological Circular). Price As. 4	Ditto .	Ditto
FRUITS		
Prunning of Deciduous Fruit Trees (Hindi and Urdu) under print. Bulletin No. 18-F. S. of the Department of Agriculture, United Provinces	R. S. Singh . . .	Superintendent, Printing and Stationery, United Provinces, Allahabad

Title	Author	Where published
FRUITS—*contd.*		
"The Loquat under print Bulletin No 19 F S of the Department of Agriculture, United Provinces	Pratap Singh	Superintendent, Printing and Stationery, United Provinces, Allahabad
Phalon ka bagh lagana (Urdu) Leaflet No 68 of the Department of Agriculture, United Provinces Free in U P only	Issued by the Department of Agriculture, United Provinces	1 Deputy Director of Agriculture, Sarda Circle Lucknow 2 Deputy Director of Agriculture, Western Circle, Aligarh 3 Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 4 Deputy Director of Agriculture, Eastern Circle Partabgarh 5 Deputy Director of Agriculture, North Eastern Circle, Gorakhpur 6 Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
A Note on Peach Cultivation in Chota Nagpur Leaflet No 4 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
For the Attention of Banana Cultivators	V Narayanan Nair	Government Press, Travancore
LAC		
A Technical Process for Washing and Refining Stick Lac Bulletin No 27 Price As 3	A K Thakur	Director, Indian Lac Research Institute, Namkum, Ranchi, Bihar
Preparation of Bleached (White) Lac Technical Note No 3 Price one anna	Issued by the Director, Indian Lac Research Institute, Namkum	Ditto
AGRICULTURAL SCIENCE		
GENERAL		
The Indian Journal of Agricultural Science, Vol VII, Parts 4 6 Annual subscription Rs 15 or 24 s (Original scientific work in the various branches of science applied to agriculture, formerly published in the Memoirs of the Imperial Department of Agriculture in India is now published in the *Indian Journal of Agricultural Science*)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi

Title	Author	Where published
AGRICULTURAL SCIENCE—*contd.*		
General—*contd.*		
Scientific Reports of the Imperial Agricultural Research Institute, New Delhi (for the year ending 30th June 1937). Price Rs. 3	Issued by the Director, Imperial Agricultural Research Institute, New Delhi	Manager of Publications, Civil Lines, Delhi
Botany		
Annual Report of Botanical Section, Bihar. Bulletin No. 8 of 1937 of the Department of Agriculture, Bihar. (In press)	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
The Genetics of Gossypium and its Application to Cotton Breeding	J. B. Hutchinson, P. D. Gadkari and M. A. A. Ansari	Director, Institute of Plant Industry, Indore
Chemistry and Physical Chemistry		
Annual Report of Chemical Section, Bihar. (In press). Bulletin No. 7 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
Preservation of Cow-dung Manure (Oriya). Bulletin No. 7 of 1937 of the Department of Agriculture, Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Compost (English). Bulletin No. 9 of 1937 of the Department of Agriculture, Orissa	Ditto .	Ditto
The Composition of Some Cattle Feeds of Burma. Bulletin No. 35 of the Department of Agriculture, Burma. Price As. 4	M. M. Menon . .	The Superintendent, Government Printing and Stationery, Burma, Rangoon
Khad (Manure). In Urdu and Hindi. Price As. 1	Dr. J. K. Dubey . .	Government Press, Bhopal
Night Soil. (Malayalam) (Leaflet). Free	Issued by the Department of Agriculture, Cochin	Director of Agriculture, Cochin, Trichur
Compost (Malayalam) (Leaflet). Free	Ditto .	Ditto
Entomology		
The Mango-hopper (Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 77 of the Department of Agriculture, Madras	M. C. Cherian . .	Government Press, Madras

AGRICULTURAL SCIENCE—*contd.*

ENTOMOLOGY—*contd.*

Title	Author	Where published
Sugarcane Pests in the United Provinces (Under print) Bulletin No 73 of the Department of Agriculture, United Provinces	B D Gupta . .	Superintendent, Printing and Stationery, United Provinces, Allahabad
Insect Diseases and their Remedies (Urdu) Leaflet No 53 of the Department of Agriculture, United Provinces Free U P only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3 Deputy Director of Agriculture, Bundel khand Circle, Jhansi 4 Deputy Director of Agriculture, Eastern Circle, Partabgarh 5 Deputy Director of Agriculture, North-Eastern Circle, Gorakh pur 6 Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
The White Fly of Cotton Leaflet No 141 of the Department of Agriculture, Punjab Free	Issued by the Department of Agriculture, Punjab	Superintendent, Government Printing, Punjab, Lahore
Surface Grass hoppers '*Toka*' Leaflet No 142 of the Department of Agricul ture, Punjab Free	Ditto .	Ditto
An Easy Method of Destroying Cactus with Cochineal Insects (Marathi) Leaflet No 14 of the Department of Agriculture, Central Provinces and Berar Free	Issued by the Depart ment of Agriculture, Central Provinces and Berar	Superintendent, Government Printing, Central Provinces and Berar, Nagpur
How to Control '*Tid*' (Urdu) Leaflet No 2 of the Department of Agricul-ture, Baluchistan Free	Issued by the Depart ment of Agriculture, Baluchistan	Agricultural Officer in Baluchistan, Quetta
Codling Moth and its Control in Balu chistan (Urdu) Leaflet No 3 of the Department of Agriculture, Baluchis tan. Free	Ditto .	Ditto
The Spotted Boll worm Pest of Cotton and how to Control It. (English and Urdu). *Gratis*	Issued by the Publicity Officer, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay

Title	Author	Where published

AGRICULTURAL SCIENCE—*contd.*

Plant Diseases

Title	Author	Where published
Sendomans Citre Disease of the Citrus (Urdu). Leaflet No. 63 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Dep ty Director of Agriculture, Bundelkhand Circle, Jhansi 4. Deputy Director of Agriculture, Eastern Circle, Partabgarh 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Wither Tip and Die Back Disease of the Citrus (Urdu). Leaflet No. 64 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	
Leaf Minor Disease of the Citrus (Urdu). Leaflet No. 65 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	
Handbook of Plant Diseases of Economic Importance in the Central Provinces. Bulletin No. 28 of the Department of Agriculture, Central Provinces and Berar. Price As. 8	Issued by the Department of Agriculture, Central Provinces and Berar	Government Printing, Central Provinces and Berar, Nagpur
How to Control Bunt of Wheat (Urdu). Circular No. 1 of the Department of Agriculture Baluchistan. Free	Issued by the Department of Agriculture, Baluchistan	Agricultural Officer in Baluchistan, Quetta

VETERINARY SCIENCE AND ANIMAL HUSBANDRY

Title	Author	Where published
Agriculture and Live-stock in India, Vol. VII, Parts 5 and 6 and Vol. VIII Part 1. Annual subscription Rs. 6 or 9 *s.* 9 *d.* (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi
The Indian Journal of Veteri ary Science and Animal Husbandry, Vol. VII, Parts 3 and 4. Annual subscription Rs. 6 or 9 *s.* 9 *d.* (A quarterly journal for the publication of scientific matter relating to health, nutrition and breeding of live-stock	Ditto .	Ditto
Agriculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10-0 or 7 *s.* 9 *d.*)	Ditto .	Ditto

Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd*		
Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and Formation of the Phrenic Nerve in the Ox with Observations on certain Anatomical Deviations Scientific Monograph No 11 of the Imperial Council of Agricultural Research, 1937 Price Rs 4 10 0 or 7 *s* 9 *d*	H N Chelva Ayyangar	Manager of Publications, Civil Lines, Delhi
Selected Clinical Articles, Part II Miscellaneous Bulletin No 15 of the Imperial Council of Agricultural Research Price Re 1 4 0 or 2 *s*	G K Sharma, R L Kaura, S Ganapathy Iyer, G S Khan and M Y Mangrulkar	Ditto
Indian Grazing Conditions and the Mineral Contents of Some Indian Fodders Miscellaneos Bulletin No 16 of the Imperial Council of Agricultural Research Price Rs 3 14 0 or 6 *s* 9 *d*	P E Lander	Ditto
A Brief Survey of some of the Important Breeds of Cattle in India Miscellaneous Bulletin No 17 of the Imperial Council of Agricultural Research Price Rs 2 or 3 *s* 6 *d*	Col Sir Arthur Olver	Ditto
Report on the Development of the Cattle and Dairy Industries of India Price Rs 1 8 0 or 2 *s* (*d*	Dr Norman C Wright	Ditto
The Indian Veterinary Journal (The Journal of the All India Veterinary Association) Quarterly Annual subscription Rs 4 or 6 *s* 6 *d* for members and Rs 8 or 10 *s* for others	P Srinivasa Rao (Editor)	The Editor, *The Indian Veterinary Journal*, 26 Wallajah Road, Madras
The United Provinces Veterinary Magazine (English and Urdu) Monthly Issued free to members of the United Provinces Veterinary Association	Issued by the United Provinces Veterinary Association	Editor, *United Provinces Veterinary Magazine*, Moradabad
The Punjab Veterinary Journal	Issued by the Punjab Veterinary Association	The Editor *The Punjab Veterinary Journal*, Lahore
The Central Provinces Veterinary Journal Quarterly	Issued by the Central Provinces Veterinary Association	The Honorary Secretary, Central Provinces Veterinary Association, Nagpur
Feed your Bullock (English) (Reprinted) Broad Hint No 1 of the Department of Agriculture Madras	G R Hilson	Government Press, Madras

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*

Title	Author	Where published
Dedication of Breeding Bulls of Ongole Breed (English) (Reprinted). Broad Hint No. 8 of the Department of Agriculture, Madras	R. W. Littlewood . .	Government Press, Madras
Diseases Affecting Poultry in the Bombay Presidency. Bulletin of the Veterinary Department, Bombay. Price one anna	R. N. Naik	Superintendent, Government Printing and Stationery, Bombay
Improved Fodder *juars*. Leaflet No. 140 of the Department of Agriculture, Punjab. Free	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
Punjab Dairying (Urdu) (Revised Edition). Price As. 13	Ditto	Ditto
Principles of Utility Poultry Breeding (Urdu). Price As. 2	Ditto .	Ditto
Fodder Crops of the Punjab. Price As. 8	H. R. Saini	Ditto
List of Horse and Cattle Fairs and Shows in the Punjab and Punjab States for the Fasli year 1937-38. *Gratis*	Issued by the Director of Veterinary Services, Punjab	Office of the Director, Veterinary Services, Punjab, Lahore
A Cheap Blow-Fly Trap (Urdu, Hindi and Gurmukhi). Leaflet No. 6 of 1937 of Veterinary Department, Punjab. *Gratis*	L. W. Smith and Sh. Mumtaz Hussain	Ditto
Note on Cattle Breeding (Reprinted). *Gratis*	T. F. Quirke . .	Ditto
Milk in Relation to Public Health (Reprinted from the Journal of the Red Cross Society, India, Vol. VI, No. 4, October 193). Leaflet of Veterinary Department, Punjab. *Gratis*	A. C. Aggarwala	Ditto
The Value of Milk as an Article of Diet (Reprinted from the Report on the Milk supply of Lahore—1930. *Gratis*	Ditto . .	Ditto
Hay-Box Method of Heating Milk for Indigenous Ghi-Making (Reprinted). Bulletin No. 8 of 1936 of Veterinary Department, Punjab. *Gratis*	W. S. Read . . .	Ditto

Title	Author	Where published
VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd*		
Some Important Diseases of Sheep in the Low Land Inundated and Water logged Areas of the Punjab with Particular reference to the Control Measures at the Government Cattle Farm Hissar (Reprinted) Bulletin No 3 of 1935 of Veterinary Department Punjab *Gratis*	Issued by the Director of Veterinary Services Punjab	Office of the Director Veterinary Services, Punjab Lahore
Sheep Breeding at the Government Cattle Farm Hissar (Reprinted) Bulletin No 4 of 1935 of Veterinary Department Punjab *Gratis*	L W Smith and Sh Mumtaz Hussain	Ditto
Goat Breeding (Jamna Pari) at the Government Cattle Farm Hissar (Reprinted) Bulletin No 6 of 1935 of Veterinary Department Punjab *Gratis*	B N Handa and D L Datta	Ditto
Live-stock at the Government Cattle Farm Hissar (Reprinted) Bulletin No 7 of 1936 of Veterinary Department Punjab *Gratis*	B N Handa	Ditto
The Art of Milking (Reprinted) Bulletin No 20 of Veterinary Department Punjab *Gratis*	A C Aggarwala	Ditto
Hints on the Management of Sheep in the Punjab (Urdu) (Reprinted) Leaflet of Veterinary Department Punjab *Gratis*	Issued by the Director of Veterinary Services Punjab	Ditto
Lecture on Cattle Breeding (Urdu) (Reprinted) Leaflet of Veterinary Department Punjab *Gratis*	Ditto	Ditto
Rinderpest (Urdu) (Reprinted) Leaflet of Veterinary Department Punjab *Gratis*	Ditto	Ditto
Mange in Sheep (Urdu) (Reprinted) Leaflet of Veterinary Department Punjab *Gratis*	Ditto	Ditto
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Foot and Mouth Disease (Urdu) (Reprinted) Leaflet of Veterinary Department Punjab *Gratis*	Ditto	Ditto

Title	Author	Where published

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*concld.*

Annual Report of the Civil Veterinary Department, Punjab, for the Year 1936-37. Price As. 4	Issued by the Director of Veterinary Services, Punjab	Superintendent, Government Printing, Punjab, Lahore
Annual Report of the Civil Veterinary Department, Assam, for the Year 1936-37. Price As. 10	Issued by the Superintendent, Civil Veterinary Department, Assam	Officer in-charge, Assam Secretariat Book Depot, Shillong
Silage (English). Bulletin No. 10 of 1937 of the Department of Agriculture, Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Annual Administration Reports of the Civil Veterinary Department, Sind and Ajmer-Merwara, for 1936-37	Issued by the Director of Veterinary Services, Sind	The Daily Gazette Press, Ltd., Karachi
Fowl Cholera (Malayalam) (Leaflet). Free	Issued by the Department of Agriculture, Cochin	Director of Agriculture, Cochin, Trichur
Nasal Granuloma (Malayalam) (Leaflet). Free	Ditto	Ditto
Rabies (Malayalam) (Leaflet). Free	Ditto	Ditto

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ICAR. 10·7. No. 7. Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng. and the Isolation of Types Resistant to the Diseases. By W. McRae, M.A., D.Sc. (Edin.), F.L.S. and F. J. F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S. (1933). Price Rs. 2-4-0 or 4*s*. 3*d*.

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ICAR. 10·10. No. 10. The Spotted Boll Worms of Cotton (*Earias fabia* Stoll and *Earias insulana* Boisd) in South Gujrat, Bombay Presidency. (Final report on investigations financed by the Indian Central Cotton Committee, 1923-1931). By B. P. Deshpande, M.Ag. and N. T. Nadkarny, B.Ag. (1936). Price Rs. 5-14-0 or 9*s*. 6*d*.

ICAR. 10·11. No. 11. Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on certain Anatomical Deviations. By H. N. Chelva Ayyangar, G.M.V.C (1937) Price Rs. 4-10 or 7*s*. 9*d*.

ICAR. 10·12. No. 12. The Fungi of India. Supplement I. By B. B. Mundkur (In the Press)

5. Miscellaneous Bulletins of the Imperial Council of Agricultural Research

ICAR. 8·1. No. 1. List of Publications on Indian Entomology, 1930. Compiled by the Imperial Entomologist, Pusa. (1934). Price As. 14 or 1*s*. 6*d*.

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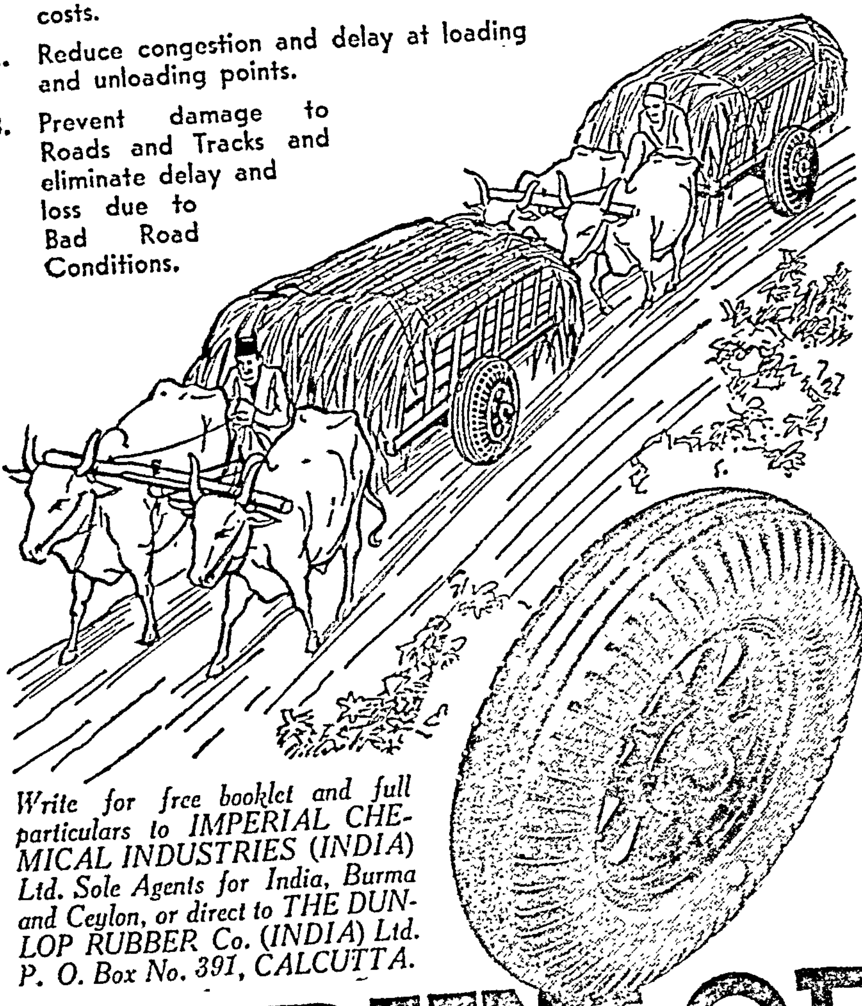

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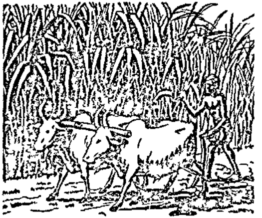

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July, 1938

The Editorial Committee of the Imperial Council of Agricultural Research, India, takes no responsibility for the opinions expressed in this Journal

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Agriculture & Live-stock in India

Vol. VIII, Part IV, July 1938

EDITORIAL

INTERNATIONAL SCIENTIFIC CONGRESSES AND CONFERENCES

INTERNATIONAL Congresses and Conferences of all sorts and dealing with all kinds of subjects, are a feature of modern life. Science is responsible for a good many of these meetings and agricultural science has its full share of them. Several conferences or congresses of agricultural interest now meet at fixed intervals of three or five years, at different places and in different countries, thus giving an opportunity for visiting scientists to see new territory and to examine, on the spot, crops, cultivation methods and field experiments, which, to be understood, must be studied on their own ground and in their own climate. Last year there was held in England the Fourth International Grassland Congress and in Berlin the Eleventh World Dairy Congress, at both of which India was represented. In the current year there will be held in Berlin the Twelfth International Horticultural Congress and the Seventh International Entomological Congress.

Another International Congress of great interest to agricultural scientists is the Seventh International Congress of Genetics, which will take place in Edinburgh in 1939 and for which the preliminary notices have already been sent out. This will be held from 23rd to 30th August 1939. The Secretary is Professor F. A. E. Crew, well known throughout the world, whose closer acquaintance was made by many scientists in India during his recent visit to the Jubilee Session of the Indian Science Congress in Calcutta.

It is hoped shortly to publish in this journal as complete a list as possible of International Congresses and Conferences of agricultural interest likely to be held during the next five years.

Delegates to International Congresses have both to give and to receive The French Colonial Minister—M Marius Moutet—speaking at the inauguration of a series of Colonial Congresses in Paris on the 20th September 1937, remarked on the influx of ideas of all kinds from all quarters, which characterise such a congress and likened it to a cross roads where many problems meet

It is astonishing how much that is taken for granted by an agricultural scientist working in one country is new to a worker in another country This is particularly true when the one worker is in a temperate zone, the other in the tropics Nothing should therefore be regarded as commonplace, for the simplest recorded practice or observation may give rise to a train of thoughts or discussion which may lead to important results in the understanding of natural processes or in the improvement of commercial or field practices Such, for example, was the excellent discussion on the indigenous plough, which took place at the meeting of the Crops and Soils Wing of the Board of Agriculture in November, 1937 Again, despite the steady improvement of abstract journals and similar facilities, for maintaining contact between scientific workers in different countries, it is still not unusual to find that isolated workers are incompletely informed of the advances made elsewhere and employ out of date methods or even unwittingly repeat a laborious investigation

In a world in which, for good or for evil, we are all now becoming so very much nearer to one another it is the more essential that we shall understand one another fully, and understanding is based on knowledge We may therefore confidently expect International Congresses and Conferences in the future to play an even greater part than in the past, in the increase of knowledge, in the advancement of science and in the development of greater understanding between peoples

The Late Mr T F QUIRKE M R C V S, I V S

OBITUARY

T. F. QUIRKE, M.R.C.V.S., I.V.S.

THE entire veterinary profession in India have learnt, with deep regret and profound sorrow, of the sad and untimely death from pneumonia of Mr. Thomas Francis Quirke, M.R.C.V.S., I.V.S., Director of Veterinary Services, Punjab, which occurred at the Albert Victor Hospital, Lahore, after a brief illness on Thursday, January 13th, 1938.

Born on June 6th, 1891, at Tipperary, Ireland, the deceased, after a preliminary education at the Clongowes Wood College, Sallins, from 1905 to 1909, joined the Royal Veterinary College, Ballsbridge, Dublin, and received his Diploma of M.R.C.V.S. in 1913. Soon after qualifying as a veterinary surgeon, he was engaged in private practice with Mr. Hamilton, M.R.C.V.S., at Ballina, for about a year before being appointed to the veterinary staff of the Irish Department of Agriculture and Technical Instruction. Mr. Quirke came out to India in February, 1915, having been appointed to the Indian Civil Veterinary Department, now known as the Indian Veterinary Service. He served for some six years as a Superintendent in this Department at Ferozepur and Rawalpindi. In June, 1921, he was promoted to the post of Chief Superintendent in succession to the late Lieut.-Colonel Farmer, and to that of Director of the Civil Veterinary Department in July, 1928. In 1929, when the Veterinary Department was separated from the Agricultural Department, he was appointed (in November) Director of Veterinary Services in the Punjab, and continued to hold this post until his death. He had thus been at the helm of veterinary affairs in the Punjab province for nearly eighteen years. As the Punjab Government appreciation stated, 'During this period the Veterinary Department of the Province has attained a growth and a fame unparalleled in India, and a large share of this success was due to Mr. Quirke's unstinted efforts, wide knowledge and unfailing enthusiasm.' The statistics given below show the progress made by the Department under the control

of Mr Quirke from the time he assumed charge as Chief Superintendent in 1920 to the time of his death —

	1919 20	1937 38
No of Veterinary Hospitals in Punjab . .	137	304
No of Outlying Dispensaries .	.	1,200
No of Stud bulls	1 352	5 370
No of Cattle Fairs and Shows held . . .	35	252
Strength of Non gazetted Staff employed in District Work . . .	192	393
Strength of Gazetted Staff employed .	15	36

In the death of Mr Quirke in the prime of his life, when only a little over 46 years of age, the veterinary profession in India has lost an outstanding member of long experience, great personality and forcefulness at a time when he was most needed Having specialised in the peculiar problems of India appertaining to the control of contagious diseases of animals, improvement of indigenous breeds of live stock and general animal husbandry matters, he best understood the difficulties of the profession, and was always out to lend a helping hand and give valuable advice to both officials and private persons The magnitude of his loss to the country as a whole, and to the Punjab in particular, will be realised by those who knew him and who had the privilege of working with and under him His diligent dutifulness, soundness of judgment, unassuming nature, simplicity of habits and outspoken criticism coupled with real kindliness and general sympathetic behaviour will long be remembered by all with whom he came in contact, either in his official capacity as the head of the Veterinary Department in the Punjab, or as a private individual As an administrator he commanded respect and his opinion in technical matters was greatly valued

"Tom," as Mr Quirke was affectionately called by his many personal friends, was a well known and popular figure in Lahore society and was closely connected with the Lahore Race Club, where, for a number of years, he assisted as a veterinary officer and as a time keeper His memory will ever remain in the hearts and minds of the people of the Punjab Province for whose sake he was always engaged in hard and enduring work [A C A] [Reprinted from the *Veterinary Record*, 12th February, 1938]

Col. SIR ... RT...

ORIGINAL ARTICLES

COLONEL SIR ARTHUR OLVER, C.B., C.M.G., F.R.C.V.S.

An Appreciation

For the last eight years Colonel Sir Arthur Olver's name has been synonymous with animal husbandry development in India. As is well known, the Royal Commission on Agriculture in India left, as its most enduring result, the Imperial Council of Agricultural Research. Sir Arthur Olver was appointed as the first Animal Husbandry Expert of this body in 1930. Sir Arthur Olver had previously had a brilliant and varied career in the Royal Army Veterinary Corps. He served in the South African War and, while attached to the Army Headquarters at Pretoria, was given special opportunities to pursue his already strongly marked bent for veterinary research under Sir Arnold Theiler. Later he was posted to the Egyptian Army as its Principal Veterinary Officer and with this new appointment there also went that of Principal Veterinary Officer of the Sudan Government. For that Government he carried out very successful campaigns against rinderpest, which was then rapidly approaching through Abyssinia in the direction of Egypt. During the Great War, Sir Arthur Olver served with the Army in France and during a mission to the United States of America did a particularly striking and useful piece of work in finding out and combating the cause of very high mortality in horses and mules shipped from the United States of America and from Canada to Europe.

Sir Arthur Olver's appointment gave a definite impetus to veterinary education and research and live-stock improvement. During his eight years in India, he has constantly had before him the idea of adequate development of agriculture on the animal husbandry side and for that purpose has applied both his scientific knowledge and his skill in organisation to the building up of both the research and development sides of live-stock industry. As a result of this energy may be mentioned the following tangible results :—

(1) the new Animal Nutrition and Poultry Research Sections at the Imperial Veterinary Research Institute, Izatnagar, where also there will be the All-India Veterinary College.

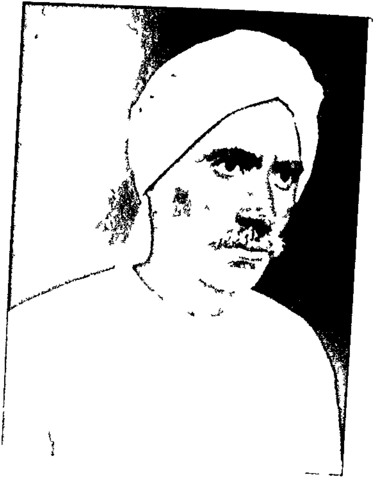
(2) the Disease Investigation Officers now in every province and certain States who are specially devoted to the study of animal diseases in

the field and who, while under control from the Centre, are of the utmost help to the Provincial Departments

(3) the many breeding, nutrition and dairying schemes which are now financed by the Imperial Council of Agricultural Research etc

(4) the greatly improved status of the whole of the live stock industry side of both the Central and the Provincial Agricultural Departments

The first All India Cattle Show held at New Delhi in February of this year was an astonishing demonstration of the nature and variety of India's cattle wealth and will long remain in the memory of all those who saw it The organisation of this was in Sir Arthur's hands His most recent publication, viz, the brochure entitled "A Brief Survey of some of Important Breeds of Cattle in India" with its collection of very striking photographs of Indian cattle, is still another noteworthy achievement of the Animal Husbandry Expert who has now retired These are some concrete examples of Sir Arthur Olver's initiation but, as is often the case, the intangible results of his eight years' work are more important His insight and wide knowledge of animal breeding and management have been of inestimable value to those with whom he has worked His influence has steadily aroused an interest in Veterinary Research which was previously lacking Sir Arthur Olver is the possessor of many well-deserved honours The Knighthood conferred on him in 1937 was a recognition of his services to India which gave great pleasure to all those with whom he had come into contact but especially to the many officers in the agriculture and veterinary services with whom he had collaborated His many friends in India wish him the full enjoyment of his well earned retirement.



The Koer cultivator of Bihar

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

. XI. THE BIHAR CULTIVATOR

BY

D. R. SETHI, M.A., B.Sc. (Edin.), I.A S.

Director of Agriculture, Bihar

Bihar is predominantly an agricultural province. With a total population of some thirty-two millions and a total cultivated area of twenty-four million acres the pressure on land is heavy. In parts of the province where agricultural conditions are favourable the intensity of population per square mile is as high as 960.

The province has three natural agricultural divisions. The river Ganges divides Bihar proper into two parts. The area lying to the north of this river and extending up to the foot-hills of Nepal is known as North Bihar. Here the predominant soil type is light alluvium, soil moisture is high and moisture holding capacity of the soil very good. There is a great diversity of crops in this area and almost all crops including sugarcane are grown without artificial irrigation. It is rare to find a field without a crop during the major part of the year. The pressure on land in this part of the province is great.

The area south of the river Ganges is known as South Bihar. Here the predominant soil type is clay and the main crops are rice, sugarcane and *rabi* cereals and pulses. Irrigation is a necessity to ensure reasonable outturns.

The third natural agricultural division of the province is the area comprising the Chota Nagpur plateau. The predominant population in this area is aboriginal and agriculture is not intensive ; the main crop being rice which depends upon the monsoon for a successful harvest.

Eighty per cent of the people depend directly on agriculture. In Bihar proper almost all communities and castes are agriculturists, and standards of cultivation vary considerably. Amongst all the cultivating classes in Bihar the most advanced are the Koeris or Kushwaha Kashatriyas. (Simple in habits, thrifty to a degree and a master in the art of market gardening the Koer is amongst the best of the tillers of the soil to be found anywhere in India.)

During his childhood the Koer indulges in the usual village pastimes and games—chiefly *kabadi* From his boyhood onwards his one passion is cultivation and he usually devotes his whole time to his work in the field Because of his thrifty habits he usually manages to keep clear of debts In years of bountiful harvests he invests all his savings in either making additions to his holding or in improving his holding by providing himself with adequate irrigation facilities or a good pair of bullocks

He knows the value of good seed, conserves his manurial resources, looks after his work cattle and goes in for intensive cultivation He rarely hires labour but makes all his family members including his women folk work in the fields The result is that in a good year he is better off than his neighbours while in a lean year he usually manages to make two ends meet

The Koer does not indulge in any expensive social ceremonies and spends very much less on marriages than other cultivating classes He is religious and as a rule avoids intoxicants

When there is less pressure of work he takes great pleasure in reciting verses from religious books and joins in musical gatherings of a religious nature.

Such in brief is the life of this hard working, intelligent and industrious son of the soil.

FIG 1 Sind *Jat* starting for work

FIG 2 Sind *Jat* ready for reaping

FIG 3 Sind *Jat* going out to cart

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XII. THE SIND CULTIVATOR

BY

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THE Sindhi *hari* or cultivator is essentially the " backbone " of Sind and, to all who have worked with and among his communities, a man worthy of admiration and respect. On account of the constant stream of immigrants into Sind from the north, the inroads of Cutchis and Marwaris from the east, and the contact with Arab invaders from the west, the cultivator population of Sind is a mixture of races in which Baluchis, Brohis, Marwaris, Cutchis, Pathans and Arabs predominate. In the north, the average *hari* is tall, robust and well-built, with a broad intelligent face, large dark eyes and a wheat-coloured complexion. Many of them wear beards and permit their hair to grow long and, in general, are impressive and striking types of mankind. In Middle Sind, the physical appearance of the *hari* is not so striking and in South Sind, this deterioration in size and impressiveness is still more marked. Similarly, as physical size decreases from north to south of the province, energy and activity also decline and the southern peoples are in general more indolent and ease-loving. However, the *haris* of Sind, taken as a whole, compare very favourably in physical characteristics and in manliness with their brothers in other parts of India. In general, the Sind *hari* is trustworthy, dependable and honest. Fond of his home and family, he works hard to support them and he is chivalrous and kind towards his womenfolk. His hospitality is proverbial and, in many cases, this trait in his character is responsible to a large degree for his pecuniary difficulties. He is intensely religious and the *pirs* or priests with which Sind abounds exercise an enormous influence over their followers in the cultivating communities. The *hari* is not as a rule superstitious but holds certain beliefs which retard his progress and which are most difficult to eradicate. For instance, it is still widely believed that the sprinkling of sand, over which the *pir* has read some incantation, over a crop will drive away white ants and that an amulet obtained from the same religious mentor will prevent the onset of disease or cure the physical illness of its wearer.

As an agriculturist the Sindhi *hari* is hard working and does not spare him self in the cultivation of his holding However he is almost invariably a tenant-at will of some zamindar or land owner, whose lands he cultivates on the *batai* or share system This system of land tenure leads to lack of interest in perma nent improvement of the fields and to lethargic and fatalistic outlook in the face of difficulties and crop failures It may be said that in Sind as in other parts of the world a good landlord makes good tenants and few land proprietors could have more useful and valuable tenants if treated properly and fairly than the zamindars of Sind The Sindhi *hari* is no more conservative than farmers all the world over and he is intelligent and quick to take up improvements if it can be proved to him that they will be of advantage to him in his cultivation

The great majority of the Sindhi *haris* profess Islam as their religion and have a common type of dress usually worn by Muslims all over Sind A large turban or *pattilo* made of coarse cloth is worn with or without a small cap A small shirt or bodice called *sadri* or *plati* generally white or indigo dyed covers his body from neck to waist while his lower limbs are encased in voluminous baggy trousers known as *shilwar* or *suthan* The poorer classes of cultivators wear the *kanch* or trousers of similar shape but inferior material The shoe of the *hari*, called *ghetlo* is a peculiar and uncomfortable looking foot wear which is generally carried in the hand during long journeys and only put on within village limits Made of heavy village cured leather such shoes will last several years and are useful weapons in self defence or in village and tribal encounters A coarse *chaddar* or sheet of homespun cloth often dyed in different colours and thrown over the shoulders or head completes a picturesque but serviceable outfit

The Sindhi *hari* is in general, a great sportsman and his favourite pastime is attendance at local wrestling matches or *malakhras* in which he often participates These matches are common features of the numerous religious fairs which are held all over Sind Competitions are arranged between the champions of different localities and raise considerable enthusiasm among the crowds of supporters No *malakhra* is complete without the attendance of a band of drums and pipes which stimulate both the competitors and the audience The successful wrestlers at a *malakhra* receive cash prizes contributed by the local well to do *haris* and zamindars

A different but no less popular recreation of the Sindhi cultivator is singing and attendance at musical renderings of local folk songs and ballads Such ballads generally deal with love episodes and religious sophisms composed by the famous Sindhi poets of the past Of these Shah Abdul Latif of Bhitshah a village in Middle Sind who lived about two hundred years ago is pre eminent for his saintli ness and art His name is a household word among the Sindhi *haris* The single wire instrument used for accompanying such musical recitals is known as the

yaktaro but pipes of different types such as the *been* or *ner* are common at village gatherings when the leisure hours are spent in story-telling and song.

On holidays and fairs the sporting instincts of the *haris* become evident in the organization of races of bullock carts, ponies or camels. Any one who has had the pleasure of attending the famous Horse Show at Jacobabad can testify to the excitement and enthusiasm which such contests evoke among the cultivators who travel incredible distances to witness them.

These are various indoor and outdoor games which the *hari* and his family indulge in as a mode of recreation. Cock-fighting is a common pastime in some parts of Sind and hunting with dogs or falcons helps to relieve the monotony of village life. The advent of perennial irrigation under the Barrage is likely to limit very severely the time available for such pursuits and recreations but the ingrained love of sport in the Sindhi *hari* will persist even under conditions of more intensive agricultural practice.

The Sindhi *hari* is not without his vices. He is generally a spendthrift and improvident and, in common with his brethern in other parts of India, is often deeply in debt to the village money-lenders. He is a true Muslim in his outlook upon strong drink but is a confirmed tobacco smoker and the *hukka* or 'hubble-bubble' is his constant companion even in the field. He is a great admirer of the opposite sex and when his admiration outruns his discretion, crimes and blood feuds become common in the district. Owing to the comparative shortage of females in Sind, such occasions are not infrequent.

With regard to his mode of living, the Sindhi cultivator likes comfort and his conditions impose upon him simplicity. His house is generally walled with mud or *od* and is thatched with reeds and branches. In the fields, he resides in a small hut or *landhi* made of plastered reeds and thatched with straw, a similar shelter being prepared close by for his cattle. In the centre of his hut, there is a square fire-place on which the housewife cooks the food and which keeps the inhabitants warm in winter. The *hari* and his family dislike sleeping on the ground and, in the hot summer season in particular, his bed is made up on raised platforms or *pehies*. In winter, a carpet made of rag patches known as *rillies* is used as a mattress. In the villages, the *haris'* huts are closely congested and built in clusters as a defensive precaution against thieves and dacoits. His furniture consists of a mat and *sandle* or wooden seat and a few simple utensils of brass and earthenware for cooking and storing his food.

The *haris'* food consists, as a rule of three meals a day. *Neran* or breakfast, prepared early, is of *jowar* or *bajri* bread, which may be lightly buttered and a bowl of *lassi* or buttermilk. *Manjhand* or lunch is generally taken at home and consists of pulse (*dal*) or vegetable. At times of special festivity or on holidays, a chicken may be added. *Lassi* is also drunk with lunch. In the evening, dinner consists of bread and vegetable with a little milk. Meat is added to the diet

about three or four times a month and generally on occasions when the villagers can share in the consumption of a goat, sheep or calf. At times of festival and ceremony a rice *pulau* of beef, mutton or chicken is provided for the feast together with sweetmeats and *gul*. The Sindhi *hari* is fond of butter and ghee, which he adds to his diet whenever it can be procured.

The Sindhi cultivator is an early riser and is punctilious about his personal cleanliness and appearance. Whenever he takes food he washes his hands and face thoroughly before eating and rinses out his mouth after the repast is over. He invariably utters the name of God (*Bismillah*) as a grace before meals. In addition to keeping his body clean the *hari* is proud of his hirsute adornments and uses unguents and oils in his personal toilet.

It would not be possible to conclude this brief pen picture of the Sind *hari* without some reference to the changing conditions of his life under perennial irrigation from the Lloyd Barrage. In pre-Barrage days the complete dependence of the Sind cultivator on the vagaries of the river Indus and its inundation season, gave rise to a fatalistic attitude towards life which has erroneously been interpreted as inertia and laziness. It was not long after the perennial water supply entered the great canals of Sind that the Sindhi cultivator began to adapt himself to the new conditions. Farming lands which do not belong to him, oppressed by poverty and debt and in many cases working for unsympathetic *kamdars* appointed by absentee landlords, the Sindhi *hari* has shown already that he is prepared to play his part in the development of his native land. All who have known Sind and its cultivators can testify to the worthiness and manliness of its "sons of the soil" and must wish them a greater degree of prosperity and comfort in the years to come.

TICK FEVER IN DOMESTICATED ANIMALS IN INDIA*.

BY

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From time immemorial mankind has been intimately associated with animals, and their utility to the human race, both as a means of transport and a source of food, was realised long before histories came to be written. Pestilential calamities that befell cattle and horses were treated empirically as were those of their owners. With the gradual development of knowledge of the various ailments of men and animals, empiricism gave way to a more accurate and systematic appreciation of the prevailing diseases. Science has provided man with ways and means of probing into the mysteries of creation and of discovering the cause of various important diseases affecting man and animal. One of the most important gifts of Science to mankind is the microscope, which aids in the better diagnosis of certain diseases, thereby enabling alleviation of suffering to be effected. For instance, the group of diseases known as tick fever in domesticated animals—with which we are concerned in this article—was known long before its causal organisms were discovered with the help of the microscope. When the causal organism of a disease was seen, another equally important problem that emerged was the determination of the manner in which a disease is disseminated from animal to animal under natural conditions. After sauntering through various avenues of scientific investigations, earlier workers have equipped us with the important information that there is yet another group of organisms, zoologically belonging to the phylum Arthropoda, which unknowingly transmit the disease from one animal to another on account of their blood-sucking habits. These are either ticks or insects.

Tick fever in live-stock is produced by micro-organisms which belong to the group of animals, zoologically placed under the phylum Protozoa. To define a protozoan is a difficult task but for practical purposes it is sufficient to know that it consists of a speck of living substance, the protoplasm, with a single regulating vital centre, the nucleus. It is due to this apparently simple organisation that the name "protozoa", which means "primitive animal", was applied to this various

* This is the tenth of a series of popular articles for practical farmers on animal husbandry subjects of general interest.

group of organisms Tick fever in animals is produced chiefly by the protozoa commonly known as piroplasms and hence "piroplasmosis" is another term employed for this affection In addition to piroplasmosis there are certain other diseases, viz —anaplosmosis, spirochaetosis—which are transmitted through the agency of ticks So we can well realise the vagueness of the term "tick fever" and therefore now a days, to be precise, the disease is designated after the particular parasite with which the animal is infected

In this article the writer has endeavoured to narrate the stories of disease producing protozoa which are transmitted to our domestic animals through the agency of ticks

As the protozoa primarily affect the blood of their hosts, a few words about the structure of blood will not be out of place here Blood is composed of two elements the liquid portion is called plasma or liquor sanguinis while the other is the cellular or corpuscular part which remains suspended in this liquid medium Of the cellular elements we can make out three distinct types of cell, viz, (1) red blood corpuscle or erythrocyte (devoid of nucleus in mammals) containing the red colouring substance or hæmoglobin in it These cells have the property of combining with the atmospheric oxygen while circulating through the respiratory organs, the lungs, and carrying this important life maintaining gaseous element to every part of the body and in turn absorbing the waste gaseous product, carbon dioxide, which is eliminated through the lungs The number of these cells per cubic millimeter of blood remains constant in an average healthy animal as shown by the following figures —

Horse—7 8 millions per cubic millimeter

Ox—6 7 to 8 8 millions per cubic millimeter

Dog—6 1 millions per cubic millimeter

(2) White-blood corpuscle or leucocyte—possesses a nucleus whose nature varies in different types of leucocytes, these cells have the power of engulfing and destroying any foreign invader in the body, and defend the body from any foreign attack Their number too per cubic millimeter of blood, is constant in an average healthy animal, (3) blood platelets—these are minute bodies which remain scattered throughout the blood system and usually appear in clusters of more than two The function of these bodies, as far as it is known, is to prevent the coagulation of blood

In order to have a first hand knowledge of blood parasites, it is necessary to adopt the following technique by which the organisms are rendered readily visible under the microscope Prick the extremity of the ear of an affected animal (except in birds where usually a small wing vein is punctured) with a finely pointed needle and as soon as the blood flows, lightly place a clean glass slide on it, so that a small quantity of blood adheres to the slide Before the

drop is dry, spread it evenly with the help of the edge of another slide. The film so made dries almost immediately. Now place a few drops of methyl alcohol (acetone-free) on the film and allow this reagent to act on it for about a minute. Flick off the alcohol and flood the slide with dilute Giemsa stain (prepared by adding one and half drop of stock Giemsa solution to 1 c.c. of neutral distilled water). This stain is allowed to act on the film for twenty minutes, after which the film is washed in running tap water for some time until a metallic lustre is visible on the film when seen against the light. The film is now ready for examination under the microscope. However, it requires considerable experience to make good blood-films and stain them satisfactorily by means of the method outlined above. It is therefore advisible to obtain assistance of trained men in matters like this and have the blood smears examined in the nearest laboratory.

Figures given at the end of the article are self-explanatory and show the common protozoan parasites of the blood known to be transmitted through the agency of ticks.

All domestic animals are liable to infestation with various species of ticks and the fact that the number of hosts and the diversity of parasites with which each host may become affected makes the subject the more interesting. When an animal becomes infected with a pathogenic or disease-producing protozoan and survives the attack, it is usually not cleansed of the infection but carries the parasite in its system in a subdued state of existence, often throughout the remainder of its life. Such animals are said to be the "reservoirs" or "carriers" of the disease and on this account in countries where the necessary transmitting agents—vectors—are available, the particular disease is comparatively easily disseminated. In their initial stages of development most of the ticks are very small. They hide in such inaccessible parts of the body of the animal that they can only with difficulty be seen by a casual observer.

Tick fever in bovines.—The most common tick-borne disease occurring practically throughout this country is "Red-water fever" (Hæmoglobinuria), characterised by the red-coloured or blood-stained urine that is commonly—though not constantly—passed by such cases. This disease in India is caused by the introduction of a piroplasm called *Babesia bigemina* (Plate XXIV, Fig. 1) into the blood of cattle presumably by ticks named *Boophilus australis*. (Plate XXIV, Fig. 2). The vector—the tick—being common throughout India, the disease "Red-water" is relatively widespread and practically all indigenous cattle acquire infection in the early period of their lives. Having acquired a natural resistance against the disease at a tender age, usually no untoward symptoms are manifested and the piroplasms establish themselves in the system of the host without causing apparent harm at that time.

Later, however, a considerable loss in condition occurs in tick-infested animal on account of a constant absorption of sustenance by the ticks, and also due to harbouring the disease-producing protozoa in a dormant state. In cows an

appreciable depreciation in milk yield may result on account of this The critical stage arises when such "carrier" animals are invaded by any other febrile disease notably Rinderpest, or when their vitality is lowered through some other cause The otherwise latent piroplasms then suddenly flare up and produce alarming complications Clinical cases of acute and severe piroplasmosis, as a primary affection, occur in cattle which are imported from territories that are free from this disease, and also in indigenous cattle that may have escaped the infection in their early life The disease can also be produced artificially by the inoculation of infected blood into susceptible bovines This piroplasm *B bigemina* as mentioned above invades the red blood cells where propagation takes place by a process known as budding It has a characteristic pear shaped appearance and occurs inside the red blood cells in pairs, joined or in contact with each other at their pointed ends Individual parasites of various shapes, however, are also met with in cases when active process of multiplication is going on The body of the parasite is seen to be largely composed of a blue staining cytoplasm while the red stained nucleus is seen to be situated towards the pointed end of the pear shaped organism The infected red blood cells, however, are ultimately destroyed

Symptoms—The disease manifests itself with a sharp rise in temperature up to 105°F or more The animal becomes lethargic, remains aloof from the herd and seeks shady places The appetite becomes depraved while thirst is increased, rumination is suspended, muffle is dry and hot to the touch The coat on the back is staring and the bowels constipated After two to three days (depending upon the severity of infection) the urine is observed to be high coloured and in certain instances presents the characteristic port wine colour This is due to the excretion of the colouring matter (hæmoglobin) of the destroyed red blood corpuscles through the kidneys The visible mucous membranes appear pale and general wasting due to anæmia occurs If timely treatment is resorted to the animal usually recovers from the malaise

Diagnosis—The most reliable method of diagnosis is by the examination of blood smears A couple of smears should be made according to the method outlined above and sent to the nearest laboratory for examination

Treatment and control—The discovery of a synthetic drug Trypanblue by Nuttall and Hadwen in 1909 as a curative agent for infection with *B bigemina* in cattle has been a boon to the veterinary profession This drug has been extensively employed all over the world as a remedy for Red-water with success It is administered in a one per cent solution, preferably intravenously, at a dose of 100 to 200 c c according to the size and weight of the animal After intravenous injection of the drug all the mucous membranes become blue, the temperature abates within twenty four to forty-eight hours while most of the parasites are destroyed In some cases more than one injection of the drug may be necessary to get the desired effect Careful nursing along with easily digestible and

The tank should be about thirty five feet long and contain about 2 500 to 3 000 gallons of dip If dipping of cattle is practised regularly infestation with ticks is considerably minimized In some places chemical sprays have been used on affected cattle but dipping tanks appear to be more effective than sprays

Other intracellular blood parasites—Another protozoan parasite with which cattle in India are perhaps ubiquituously infected is *Theileria mutans* (Plate XXIV, Fig 3) This is a comparatively small parasite also inhabiting the red blood cells of the host *Theileria mutans* as it occurs in this country has not been observed to cause any ill effects in ' carrier animals even when the vitality of these animals is lowered due to some intercurrent febrile diseases or to some other cause Recently another Theileria parasite, *Theileria annulata*, has been recognised to cause an appreciable mortality amongst cattle in India specially in imported animals The disease caused by this organism has also been recorded from hill cattle at Mukteswar where it has been found to run a very acute and frequently fatal course Theileria parasites are much smaller than *B bigemina* measuring about one micron[1] in diameter The parasites show a multiplicity of forms namely, round oval, and rod or comma shaped In *T annulata* (Plate XXIV, Fig 4a) the round or ring forms are predominant, i e, about eighty per cent being round forms while in *T mutans* the ratio of ring to other forms may be about forty five to fifty five per cent The body of the parasite contains very little cytoplasm and is chiefly composed of a ring of cytoplasm with the nucleus situated at the border Propagation or multiplication in *T annulata* takes place by means of a process called schizogony in the cytoplasm of the large mononuclear leucocytes of the internal organ, chiefly lymphatic glands spleen and liver Such multiplying forms or schizonts are often called Koch s bodies (Plate XXIV, Fig 4b) Koch's bodies are invariably encountered in the peripheral circulation in infection due to *T annulata* Blood from infected cattle showing Koch's bodies is easily inoculable into susceptible bovines In infection due to *T mutans* Koch's bodies are very rarely seen Propagation in this species chiefly occurs by a process of division of the parasite into two or four daughter individuals inside the red blood cell It is presumed that infection in cattle due to Theileria parasites is brought about by the bites of infected ticks [probably *Hyalomma aegyptium* (Plate XXIV, Fig 8) in India]

Symptoms—As mentioned above infections due to *T mutans* do not produce any ill effects The symptoms are therefore of but little value when compared with cases due to *T annulata*

The disease due to *Theileria annulata* as observed among imported and as well as hill cattle under natural conditions is usually of a very acute type The mortality is very heavy, being sixty to seventy per cent or more The incubation period on artificial inoculation ranges between fourteen to twenty one days, and the first symptom of the disease is the rise of temperature to 104 106°F

[1] One micron (μ) is equivalent to 1/1000 of a millimeter

The parasite may not be demonstrated in the peripheral blood for four or five days after the onset of fever. Lachrymation and flow of saliva are almost constant symptoms. In the beginning constipation is observed which, as the disease progresses, may lead to diarrhœa with passage of blood. A very characteristic and a predominant symptom is that of enlargement of the superficial lymphatic glands, *viz.*, the prescapular and the precrural. In view of the fact that the lymphatic glands comprise one of the predilection seats of multiplication of the parasite, a very reliable means of diagnostic confirmation of the disease is afforded by the microscopical examination of the fluid extracted by puncturing one of these glands with a hypodermic needle. The liver and spleen become considerably enlarged in Theileriasis. Ecchymosis is present in almost all the internal organs. The kidneys become highly congested and in several cases infarcts are observed on the surface. Hæmoglobinuria is absent in spite of a heavy destruction of the red blood cells. From the onset of fever the course of the disease in acute cases does not usually exceed a week or ten days. The affected animals refuse all kinds of food and have to be hand-fed with milk, gruel and other nourishing diet

Treatment.—Drug treatment of acute Theileriasis in cattle has so far baffled veterinary workers and none of the various drugs so far tried have proved to be of any marked value. Usually 30 c.c. of one per cent solution of Plasmoquin is administered intravenously, but Atebrin has been found to give best results in experimental Theileriasis. Stress, however, must be laid on good nursing, stimulants and the administration of such agents as are likely to maintain the vitality of sick animals.

Anaplasmosis.—Anaplasma are minute spherical structures that occur in the red blood corpuscles of cattle and, perhaps in many other domestic animals. Opinions vary widely in regard to the true nature of these structures. Two different species namely, *A. marginale* (Plate XXIV, Fig. 5) and *A. centrale* have been recorded from cattle, but in India the former only has so far been recognised. It measures from 0·1 to 0·5μ in diameter. Infected red cells containing more than one parasite are not infrequently met with in heavily infected cases.

Anaplasmosis as a distinct disease entity is on record from all parts of the world. In popular terms it is known as "gall sickness" owing to symptoms of jaundice associated with fever that are observed in this condition. Affected cases show mucus discharge from nostrils, lachrymation, and constipation followed by diarrhœa. No hæmoglobinuria, as in Red-water, is present but the urine is of deep yellow colour. Usually very severe anæmia results and the mortality in acute cases is fairly high.

Treatment.—Sodium cacodylate, an arsenic preparation, has been tried with successful results. Repeated injections of 80 grains dissolved in four ounces of normal saline solution given intramuscularly are necessary to overcome the ill effects of the disease.

Tick borne diseases of sheep and goats—Three different species of *Babesia* in all probability communicated through the agency of ticks, are known to cause disease in sheep and goats These are *B motasi*, *B sergenti* and *B ovis* Besides these there is a species of *Theileria* namely, *T ovis* also reported from our country All these parasites mentioned above infect the red blood corpuscles of their hosts It must be admitted however that very little attention has so far been paid to the study of the disease caused by these parasites in this country With the exception of a few records of scattered clinical cases no further observations are available

Babesia motasi (Plate XXIV, Fig 13)—This is the largest of the piroplasms that invade the red cells of sheep and goats and give rise to symptoms and lesions indentical to those caused by *B bigemina* in cattle Morphologically also it bears a close resemblance to *B bigemina* It occurs in pairs and measures about 2 5—4μ in dimensions Hæmoglobinuria is a characteristic symptom of this disease

Babesia ovis (Plate XXIV, Fig 14)—This parasite is smaller than *B motasi* measuring about 1—2 5μ in length Although double pear shaped forms are sometimes met with in blood smears this parasite usually occurs singly and has a tendency to occupy a marginal position in the red cell The round forms are, however the most common The acute phase due to the infection with this parasite is manifested by fever jaundice and progressive anæmia

B sergenti (Plate XXIV Fig 15)—This is the smallest of the *Babesia* recorded from sheep and goats Rounded and bacillary forms occur in the red cells Division takes place by means of budding

Excepting *B motasi* which is transmitted through the tick *Rhipicephalus bursa* no precise information regarding the tick involved in the transmission of other *Babesia* is available The tick *R bursa*, however, has not so far been found to occur in India

Theileria ovis (Plate XXIV, Fig 16)—In a "carrier" condition this parasite is not infrequently met with in the blood of sheep and goats No evidence of disease due to Theileria infection in these animals is recorded from this country Transmitting agent is not known as yet

Anaplasma marginale (Plate XXIV, Fig 17)—This parasite bears the same relation to the infected red cells of sheep and goats as it does in cattle No symptoms of any disease are however, indicated in sheep and goats "Carrier" animals may show it in the blood due to some other intercurrent disease Nothing is known about its transmitting agent

Tick borne diseases in horses—In the horse two species of *Babesia* are known to be transmitted by the agency of ticks These are *B caballi* (Plate XXIV,

Fig. 6) and *B. equi* (Plate XXIV, Fig. 7) (often called *Nuttalia equi*). The former is the bigger of the two and resembles morphologically *B. bigemina* of cattle. It occurs in the red blood cells of the host in the characteristic double pear-shaped forms and divides by a process of budding. As a result of infection high fever followed by hæmoglobinuria is not infrequently met with in acute cases.

Treatment.—Trypanblue is the drug of choice for infection due to *B. caballi.* An intravenous injection of 100 to 200 c.c. of one per cent freshly made solution is recommended.

B. equi.—Perhaps in India equine piroplasmosis is more commonly due to *B. equi* infection than the previous species. This, as mentioned above, is the smaller of the two parasites and occurs singly in the red blood cells of the host. Division takes place by budding and four newly-formed daughter individuals are often seen to arrange themselves in a manner which gives the group the characteristic appearance of a Maltese cross (Plate XXIV, Fig. 7)

Jaundice is a characteristic symptom ascribed to this infection. Hæmoglobinuria is absent. Very high fever rising up to 106°F. or more has been observed in the imported animals. The particular tick which carries these infections in India is, however, not known, but *Hyalomma aegyptium* has often been suspected to infest equines in this country.

Treatment.—Very successful results have been achieved by the administration of quinine hydrobromide in *B. equi* infections. The dose is one grm. dissolved in water given intravenously and sometimes more than one injection may be necessary to combat this infection. In some cases the administration of this drug has caused some alarm owing to a depressant action, but the untoward symptoms can easily be overcome by the injection of a suitable dose of strychnine hydrochloride.

Tick fever in dogs.—Perhaps no other disease of dogs is so widespread in India as tick fever. Imported dogs are more severely affected than those bred locally, but nevertheless quite a large number of the latter succumb to tick fever. Those which survive are usually adult dogs that had probably become infected as puppies and thereby developed a tolerance to the disease.

With most of the Hunts in India, and dog fanciers, who own imported dogs, tick fever is, undoubtedly, an indomitable pest.

One attack of the disease does not always confer an immunity and a dog that once becomes infected and passes through tick fever, is liable to relapse. Furthermore, there is evidence which points to the conclusion that the virulence of the causative agent varies in those parts of the country where the disease is endemic. So that those dogs that may have successfully survived an attack

in one part of the country may become severely affected when taken to another part, and die Two species of *Babesia*, namely, *Babesia canis* and *B gibsoni* are recognised in India They invade the red blood corpuscles of dogs and give rise to the disease popularly known as tick fever Although *B canis* was first discovered in the blood of dogs in 1895 by Piana and Gallivalerio in Lombardy, it was not until 1915 that Webb and Christophers showed this parasite to occur in India also *B gibsoni* was first seen by Patton in 1910 in the blood of the dogs of the Madras Hunt and in the jackal Now, however, it is believed that tick fever in dogs in India is perhaps most commonly due to *B gibsoni* infection Mixed infection due to both the species is also met with

B canis (Plate XXIV, Fig 9) is a large parasite occurring in the double pear shaped forms identical to *B bigemina* of cattle Individual parasites of various shapes, *viz* round, oval, amœboid, are also met with in cases where active multiplication by a process of budding is going on

The dissemination of *B canis* has been proved to take place by the bite of the common dog tick *Rhipicephalus sanguineus* (Plate XXIV, Fig 10) But in the case of *B gibsoni* in addition to the tick just mentioned there is another vector which is called *Haemaphysalis bispinosa* (Plate XXIV, Fig 12) Both the ticks belong to the class of "dropping off ticks" and apart from imparting infection in their larval nymphal, and adult stages, it has been recently demonstrated by Shortt that hereditary transmission of *B canis* takes place through the eggs of *R sanguineus*

Babesia gibsoni (Plate XXIV, Fig 11) morphologically simulates the Theileria parasite of cattle Its usual shape is that of a small ring Occasionally bigger parasites of various shapes and sizes are also seen in smears made from heavily infected cases The parasite measures 0 5 to 2 μ in diameter The nucleus is represented by a dot usually placed at the border of the ring In heavily infected cases the red blood cells may be crowded with parasites but usually only one or two parasites occur in a cell

Symptoms.—Dullness inappetence, and dryness of the nose are the premonitory signs The temperature gradually rises to 103°F and may at times reach 106°F The coat appears to be rough and staring and the breath has a foul odour Constipation is invariably present which is subsequently followed by diarrhœa The urine at this stage is of high colour

In cases of *B canis* infection hæmoglobinuria may be observed The mucous membrane of the mouth and eyes appear pale and gradual wasting takes place Sometimes the cornea may become opaque The blood becomes thin due to the destruction of the red cells The liver and the spleen are considerably enlarged The mucous membrane of the internal organs are seen to be stained with bile pigment When the disease is prolonged for some time a complication such as

pneumonia usually supervenes and kills the dog. The temperature drops after four or five days to 100 or 101°F. to rise again within a short while. When the disease is well advanced, food is totally refused.

Treatment.—Several drugs have been tried by various workers with good results. These are :—

Trypanblue, Acaprin, Novarsenobillon, Sulfarsenol and Tryparsamide.

Trypanblue.—This is an aniline dye and is a very successful agent in regard to *B. canis* infection. The dose is 1 c.c. of a 1 per cent solution in normal saline solution given intravenously per every 5 lb. body-weight of the animal. If fever continues the dose may be repeated after an interval of five to six days. This drug has no effect on *gibsoni* infection.

Acaprin.—This drug is a recent introduction in the domain of treatment of canine piroplasmosis and has been reported to be highly efficacious for *B. canis* infection. The dose is 1-2 c.c. of 1 per cent solution introduced subcutaneously. This drug too has failed to act on *gibsoni* infected cases.

Novarsenobillon.—This is an arsenical preparation and is administered intravenously. For a dog weighing 40 lbs., 0·45 grms. of the drug is dissolved in 5 to 10 c.c. of distilled water and given by the intravenous route. For smaller animals the dose is reduced proportionately. This drug is very successful in combating *canis* infection, and has proved of use in *gibsoni* infection also.

Sulfarsenol.—This also is an arsenical compound and is as efficacious as the previous drug with an additional advantage that it can be administered subcutaneously. The dose for a dog weighing 40 lbs. is 42 centigrammes dissolved in 20 c.c. of distilled water. It can be obtained in sealed ampoules of various doses.

Tryparsamide.—It is an arsenical compound and has been preferred by some workers for cases infected with *B. gibsoni*. It can be given either subcutaneously or intravenously. The following doses, according to the size of the animal, are to be dissolved in 5-10 c.c. of distilled water :—

0·42 grms. for small dogs.

0·85 grms. for medium size dogs.

1·7 grms. for hounds.

Five to eight injections given at an interval of five days may be necessary to affect a cure.

In addition to the drug treatment, good nursing and proper hygienic surroundings are necessary. Fresh water and clean bedding should always be provided for the sick dog under treatment. Nourishing food, such as eggs, soup, milk and chopped liver are necessary to preserve the vitality of ailing animals. Occa-

sionally a dose of Epsom salts should be given to keep the bowels clean When the disease has been overcome a course of good tonic should be given

Control —Where a pack of hounds is maintained for sporting purposes it is essential to house the animals in tick proof kennels The building should contain a minimum of wood work as the ticks hide in the crevices It should be surrounded by a moat four inches in width and three inches in depth in which a solution of phenyle or other agent is maintained Another moat about half way up the inside wall is also preferable as the ticks have a tendency to climb to the ceiling from where it is difficult to dislodge them The inside of the kennels should be frequently washed with disinfectants or burnt with a blow lamp Before the dogs are introduced into such kennels an endeavour should be made to de tick them as far as possible In badly infested dogs a dressing with kerosine oil emulsion followed by a hot bath should be practised as this procedure will render them tick free Dipping has also been practised in some places with successful results

Tick fever in poultry (Spirochaetosis) —Thread like spiral organisms found in the blood of poultry have been shown to be transmitted by the tick, *Argas persicus* Tick fever or spirochaetosis in poultry is of wide spread occurrence in this country and causes enormous loss in fowls Ducks, geese, turkeys and canaries are, however, susceptible to this disease when infected blood is introduced into them Pigeons are as a rule resistant to infection The tick *Argas persicus* (Plate XXIV, Fig 19) when once infected with the spirochaete transmits the infection to its progeny through the medium of its eggs A fowl not only gets infected by the bite of an infected tick but infection can also be brought about by the ingestion of these ticks by the bird

Treponema anserina (Plate XXIV, Fig 18) (also known as *Spirochaeta gallinarum*) the causal agent, is a thin cork screw like organism and is found to wriggle about freely in the affected blood It measures about 20μ in length nd 0 5 to 1 5 μ in breadth Multiplication takes place by fission or breaking up of a single thread like organism into two or more such organisms

Symptoms —The onset of the disease may be so sudden and acute as to cause death of the affected birds within twenty four hours before any symptoms have been exhibited In the less acute form there is dullness, ruffling of feathers, and diarrhœa, the stool often being of a greenish colour The comb becomes pale owing to anæmia The temperature reaches 110°F to 112°F and has a tendency to drop suddenly In the chronic type that may follow the acute phase, paralytic symptoms are observed The wings drop and the neck is twisted towards one side The legs are also involved and the affected bird is noticed to crouch or lie down Great emaciation usually follows a severe attack The spleen and liver are greatly enlarged and the blood becomes thin and dark

Treatment.—Arsenical preparations, *viz.*, Soamin and Atoxyl have proved to be very reliable drugs in the treatment of fowl spirochætosis. Of a 1 per cent solution 1-2 c.c. (or more, according to the weight of the body of the bird) is injected subcutaneously or intramuscularly. Two or three injections are sufficient to cleanse the circulating blood of the organisms. These drugs can also be used in a prophylactic manner.

Prevention.—This consists in ridding the fowl houses and birds of ticks. Dressings with petroleum or turpentine for the birds are effective in de-ticking them. The roosts and the nest should be burnt with a blow lamp. Kerosine emulsion, lime and creosote are advocated as sprays for the fowl houses.

The above account is but a very small part of the various types of diseases with which the live-stock of our country usually suffer. With our increasing knowledge about the behaviour of the causative organism and the transmitting agent we are now in a position to diagnose most of the protozoal diseases at an early stage and treat the malady. Still we have not reached a stage where we can cry ' halt ' to our investigations into the various untrodden avenues of implicate problems which have direct bearing to the well being of our live-stock. In order to improve the general health of our domestic animals, which, it must be admitted, is far from satisfactory, it is essential that our live-stock owners even in the interiormost villages of the country became thoroughly conscious of the problems that confront them, and established a close contact with the Disease Investigation Officers of their respective provinces.

It must be remembered that it is only by well considered and properly planned methods that remedial measures yield the desired beneficial effect.

EXPLANATION OF PLATE

PLATE XXIV

Fig 1 *Babesia bigemina* —Intracorpuscular parasites of cattle producing ' Red water fever " Note the paired arrangement of the pear shaped organism

Fig 2 *Boophilus australis* —Vector of above

Fig 3 *Theileria mutans* —Common blood parasite of cattle Note one ring and other rod form parasite inside the same red blood cell

Figs 4-a b *Theileria annulata* —Two forms of the parasite commonly met with in the blood of cattle suffering from acute Theileriasis 4 a—ring form 4 b—showing the parasite multiplying inside a large mono nuclear white blood corpuscle This is known as Koch's body

Fig 5 *Anaplasma marginale* —A blood parasite which is not infrequently met with in cattle It is known to produce jaundice accompanied by fever

Figs 6 7 *Babesia caballi* and *B equi* —Blood parasites of equines *Babesia caballi* produces fever and sometimes hæmoglobinuria while infection with *B equi* is characterised by very high fever and jaundice In Fig 7 note the ring form and the dividing form simulating Maltese cross

Fig 8 *Hyalomma aegyptium* —Suspected vector of equine species of Babesia and Theileria parasites of cattle

Fig 9 *Babesia canis* —Blood parasite of dog—known to produce hæmoglobinuria and jaundice Four pear shaped organisms seen within one red blood cell

Fig 10 *Rhipicephalus sanguineus* —Vector of above

Fig 11 *Babesia gibsoni* —Another blood parasite of dog—known to produce anæmia and high fever Note three parasites of different shapes inside the same red blood cell

Fig 12 *Hæmaphysalis bispinosa* —Vector which has recently been shown to transmit the above parasite

Figs 13 17 *Ovine piroplasms* —

Fig 13 *B motasi* —Largest of the piroplasms of sheep and goat Known to produce hæmoglobinuria

Fig 14 *B ovis* —Presence of this parasite in the blood produces fever, jaundice and progressive anæmia in acute cases

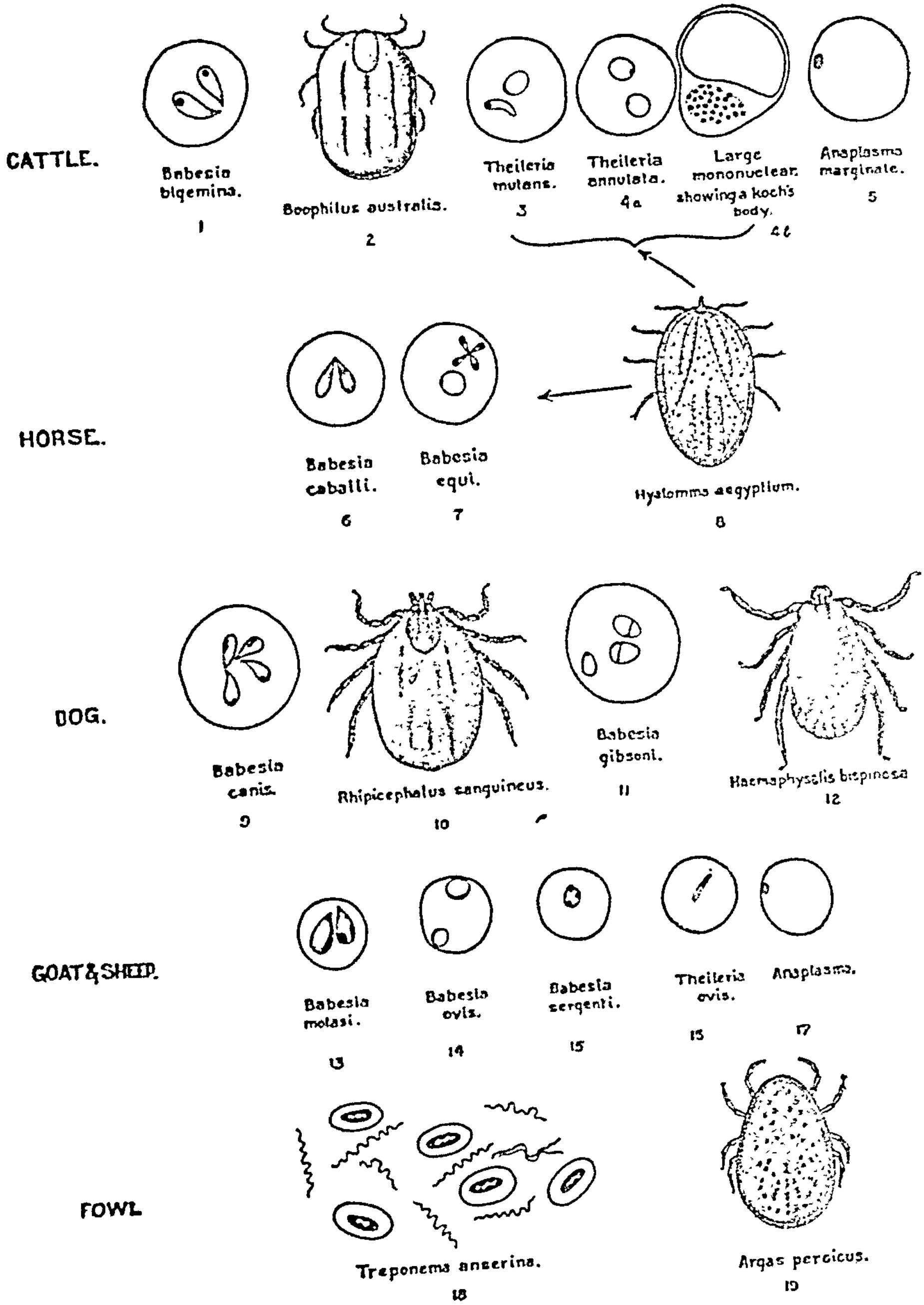
Fig 15 *B sergenti* —This is the smallest of Babesia recorded from sheep and goat

Fig 16 *Theileria ovis* —This blood parasite is not infrequently met with in sheep and goats of our country

Fig 17 *Anaplasma* —Blood parasite resembling *A marginale* of cattle No symptom of any disease is however indicated in sheep and goats

Fig 18 *Treponema anserina* —Causative agent of tick fever in fowls Organisms are shown as spiral threads The oval nucleated structures are the red blood corpuscles of the bird This organism unlike those mentioned above is extracellular in habit

Fig 19 *Argas persicus* —Vector of above


CATTLE.
Babesia bigemina.
1
Boophilus australis.
2
Theileria mutans.
3
Theileria annulata.
4a
Large mononuclear showing a koch's body.
4b
Anaplasma marginale.
5
HORSE.
Babesia caballi.
6
Babesia equi.
7
Hyalomma aegyptium.
8
DOG.
Babesia canis.
9
Rhipicephalus sanguineus.
10
Babesia gibsoni.
11
Haemaphysalis bispinosa
12
GOAT & SHEEP.
Babesia motasi.
13
Babesia ovis.
14
Babesia sergenti.
15
Theileria ovis.
15
Anaplasma.
17
FOWL.
Treponema anserina.
18
Argas persicus.
19

THE VALUE OF *AUS* PADDY STRAW AS A FODDER

BY

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THE *Aus* paddy crop is a highland crop sown about the middle of March to May and harvested about mid-June to mid-November. It is the earlier rice crop, the name originating from the Sanskrit word "Ashu " meaning early or quick. Its normal acreage in the Presidency of Bengal is over six million (6,053,500) acres, the total paddy area being nearly 23 million acres, *i.e.*, more than a quarter (26·42 per cent) is under this crop. Of this area (under *Aus*) nearly fifteen per cent is in the Nadia District and ten per cent in the Mymensingh District. In most other districts the area is much limited, ranging from one to five per cent, whilst the lowest areas are in Darjeeling (0·06 per cent), Howrah (0·15 per cent), Hooghly (0·32 per cent) and Chittagong Hill Tract (0·94 per cent).

It will be obvious, however, that occupying as it does more than 26 per cent of the total paddy area in the province, its place as a source of fodder is not such as could be looked upon with neglect. Yet popular opinion about this fodder is very curious and even conflicting. In some localities it is considered as a good fodder, in others there is an impression that it reduces the yield of milk. Its harvest period falling often during the height of monsoon no doubt offers great difficulties in the way of proper drying and storage. This might affect the quality to a great extent.

At the same time it should be remembered that, unlike *Aman* paddy, this crop is harvested before it is dead ripe. One of the essential factors during the process of ripening is the transfer of nutrients from the straw to the grain. But being harvested somowhat earlier, some of the nutrients are likely to be held up in the straw. The analysis and digestion experiment with this straw also show that it holds definite superiority over *Aman* or winter straw. In fact, its position is something like oat straw in Great Britain, which on account of identical reasons (of being harvested before it is dead ripe) is found to be a more valuable fodder than wheat straw or barley straw.

The analysis of *Aus* straw shows that it is much richer in protein (5 88 per cent), oil (1 71 per cent) and lime (0 64 per cent), as compared to *Aman* straw It is also definitely richer in other minerals such as magnesia, potash and phos phate One of the chief criterions of a feed is its protein content and in this respect it appears to be superior to other kinds of paddy straw so far tested in India It seems to be even better than American and European varieties

It should be stated here that, although composition is a rough indication of the nature of feed, its real value depends on its nutritive effect which can only be ascertained by conducting careful tests The nutrition section at the Dacca Farm started under the grant of Imperial Council of Agricultural Research recently con ducted feeding and digestion tests with this straw and the results point to definite superiority of this fodder over that of *Aman*

The primary requisites for the continuance and proper functioning of life are that (1) there should be reasonable supply of protein material for body building and repair of waste (2) sufficient energy from food to maintain body heat and enable the system to function properly during rest, growth, work, milk production etc , and (3) mineral matters so vitally necessary for the frame work of the whole body and maintaining proper reaction of the blood The presence of vitamin is no doubt necessary and while this is generally deficient in dried straws, this straw is more likely to contain some since it is harvested at a time when it is still partially or slightly green

The protein in digestible condition must form certain minimum proportion of the total digestible nutrients This proportion under Bengal requirement is prob ably about 1 16 In the case of European animals, which are brought up under a much higher plane of nutrition, this proportion is much higher, being about 1 8 to 1 12 If the proportion is very low the animal in its struggle for life has to draw the amount from the reserve of its own body with the result that it loses condi tion and when it loses condition it fails to make the proper utilization of the other nutritive constituents, even though they may otherwise be quite sufficient Thus, in so far as energy value is concerned the difference between *Aman* straw and *Aus* straw is practically negligible yet because *Aus* straw contains on one side more protein (both in total and digestible form) and on the other better supply of lime and phosphorus, it helps in the process of digestion and thus throws out a larger amount of net energy and total digestible nutrients weight for weight, thereby offering a definite advantage over *Aman* straw This can be best illustrated in the following table where the results have been computed per hundred lbs of dry straw both for *Aman* and *Aus* and at the same time it has been also shown how in the case of *Aman* a small supplement of concentrate (as cake) makes for better economy

TABLE I

Feeds	Dry matter	Digestible protein	Total digestible nutrients	Energy as starch equivalent	Nutritive ratio	When *Aman* is 100	
						T. D. N.	S. E.
Aman straw when given alone	100·0	—0·47	37·05	24·396	?	100·0	100·0
Aus straw when given alone	100·0	+1·77	43·02	28·761	1 : 23	116·11	117·892
Aman straw when given with Cake.	100·0	+0·387	44·11	29·519	1 : 113	119·06	120·999

These results show two striking facts—one that when fed singly *Aus* straw provides about sixteen per cent more total digestible nutrients and about equal quantity more energy than *Aman* straw under the same condition and that this is chiefly due to a better availability of protein and mineral nutrients than in *Aman* straw; secondly, a small addition of concentrate (as in the case of *Aman* straw) contributes more towards real economy by throwing open much larger amount of total digestible nutrients and energy supply.

At this stage another highly important factor has to be stated. *Aus* straw, although definitely richer in digestible protein and mineral than *Aman* straw, does not still contain as much as is necessary for proper maintenance. So a small dose of concentrate helps in various ways. Its protein content being higher, a smaller dose of concentrate will be enough to give an approximately equivalent result which in the case of *Aman* paddy will require more. In other words, *Aus* straw is economical in two or three ways—one because it is initially richer than *Aman* straw in protein and minerals and, secondly, because of this initial advantage it requires as a supplement only a very small quantity of concentrate, and thirdly, the small supplement of cake is followed by an increased consumption so that the mineral side is largely satisfied.

It should not be forgotten that *Aus* and *Aman* straws are only roughages and it is rarely the case that a roughage by itself is a complete and well-balanced feed. A small dose of concentrate is always a necessity and is to the ultimate advantage.

This can be best judged from the following experiments with *Aus* straw. Here nine animals were divided into three lots ; (1) one lot was given only *Aus* straw, (2) the second lot was given a supplement of half lb. of linseed cake with straw and the (3) third lot $\frac{3}{4}$ lb. of cake plus straw. The straw was given *ad lib., i.e.,* as much as they could eat. All the animals were given requisite amounts

of salt and water Their daily live-weights were recorded The experiment lasted for forty one days Unfortunately the supply of straw was not sufficient to continue the feeding longer To ascertain the amounts digested, the collection of feed faeces urine etc, was conducted for ten consecutive nights and days and the average per day was worked out from the figures

As live weight is one of the main indications of the nutritive effect of a feed it is shown as follows —

TABLE II

Group	Period of feeding	Average live weight			
		Animal No	At start	At end	Loss or gain in live weight
					Lb
Aus straw only	41 days	D_1	487 9	488 2	+0 3
		D_3	533 4	525 2	—28 2
		D_7	481 9	459 6	—22 3
Aus straw and ½ lb cake	41 days	D_2	517 6	527 6	+10 3
		D_6	440 5	451 0	+10 5
		D_9	591 3	599 2	+7 9
Aus straw and ¾ lb cake	41 days	D_4	529 0	547 6	+18 6
		D_5	468 5	480 0	+11 5
		D_6	550 4	552 0	+1 6

It will be noted from this that during the course of forty one days, two out of three animals under "*Aus* straw only" lost about two stones in their live-weights One of the animals D_1 remained stationary This is most likely due to better individual efficiency of this animal but a longer period of feeding might possibly have reflected in a loss of its live weight also The addition of half a lb of linseed definitely contributed towards an increase of their live weights With ¾ lb cake, two animals have shown greater increase, but one, *viz* D_6, has remained almost stationary This again might be due partly to lower individual efficiency of this animal as opposed to higher efficiency noted in the case of D_1 and partly to its heavier weight Evidently this animal (D_6) probably needed a still larger dose of cake The results generally are however convincing and show how a small supplement of cake is indispensable for proper utilisation of roughage.

In fact, its benefit is reflected in better consumption, *i.e.*, better appetite, larger availability of total digestible nutrients and in greater thriftiness. This will be illustrated from the average values as shown under the following table.

TABLE III

Nutrients per day from straw computed per 1,000-lb. live-weight

	Consumption from straw		When straw is 100	
	Dry matter	Total digestible nutrients	Dry matter	Total digestible nutrients
	Grm.	Lb.	Grm.	Lb.
Aus straw only . . .	12·184	5·259	100·00	100·00
Aus straw and ½ lb. cake .	15·315	6·543	125·655	124·534
Aus straw and ¾ lb. cake .	15·601	6·148	128·003	117·016

For a proper comparison all the values here have been converted on the basis of 1000-lb. live-weights. It will be seen that the addition of cake has increased the appetite, (*i.e.*, consumption) to 25·66 per cent with ½ lb. cake and 28·00 per cent with ¾ lb. cake. The total digestible nutrients also exhibit still increasing percentages. The somewhat low average of ¾ lb. is due to low individual efficiency of an animal D_6.

It is necessary to add here that under the condition of feeding in Bengal not only is there a deficiency in protein supply but there is an equally poorer supply of mineral. In the case of rice straw feeds the lime supply mainly comes from the share of straw, but experiments at Dacca have shown that the lime from straw is not as readily assimilable as probably from other feeds, and on this account a comparatively larger quantity (about twenty-four grms. per 500-lb. live-weight) is required. The supply of phosphorus from straw is also very low and this can be supplemented by cake which will also make up the protein deficiency. It has been found that the addition of about half a lb. linseed cake has supplied the protein and phosphorus needs on one side and by increasing the consumption of straw has helped in a positive lime balance.

It should be the aim of every intelligent cattle owner that not only does his animal receive requisite supply but that under the existing shortage of supply every possible attempt should be made of the most economic utilization of the limited resources that the country is able to provide at present.

In this investigation the behaviour of *Aus* straw on milk yield could not be included as the supply of straw was much limited Its general richness in vital constituents is definitely more in its favour than with *Aman* straw, but pending trial it would be advisable that while feeding milch cows the behaviour should be carefully watched The most deciding factor appears to be associated with the quality of the straw, and if it is stored badly and becomes mouldy it is bound to be deleterious in effect

The investigation on *Aus* straw so far shows that

(1) Weight for weight it is a better fodder than *Aman* straw.

(2) It is richer in protein and minerals and hence requires lesser amount of concentrate than *Aman* straw

(3) It is harvested when it is slightly green and hence is likely to be better provided in vitamins

(4) It occcupies more than one fourth of total paddy area of Bengal, and every attempt should be made to conserve and store this valuable fodder properly and carefully

PRELIMINARY NOTE ON THE BEHAVIOUR OF RICE *KURA* (BRAN) AS A CATTLE FEED

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The estimated outturn of different kinds of paddy in Bengal is about 280 million maunds or over ten million tons. It is not exactly known how much of it constitutes rice bran and how much rice polish. Fraps [1916], however, carried out a comprehensive investigation in U. S. A. and he found that the average yield of products and by-products per bag of 162 lbs. paddy was as follows :—

TABLE I

Variety	Per 162 lb.			Per cent*		
	Hulls	Bran	Polish	Hulls	Bran	Polish
Japan . .	29	14	5	17·90	8·64	3.09
Honduras .	34	15	5	20·99	9·26	3.09
Blue rose .	29	13	4	17·90	8·02	2·47

It will be noted from this table that bran and polish together constitute about ten to twelve per cent of paddy. On a similar basis if we assume 8·5 per cent as bran and three per cent as polish, the by-products available from rice manufacture in Bengal would work out at 23·8 million maunds bran and 8·4 million maunds as rice polish, giving a cattle food to the tune of over thirty-two million maunds. In a country so poorly supplied with concentrates for cattle, the value of such a large amount of an important by-product cannot be over-estimated.

At present a very large proportion of rice in Bengal has to pass through milling process by which the bran is largely or entirely removed. This bran consists of the seed coat, the embryo and the greater part of the oily aleurone layer.

The proteins of rice and rice bran are credited with high biological value amongst cereals. Mitchell and Villegas [1923] give the value of bran protein

*Calculated from Frap's figures.

as sixty eight Maynard, Fronda and Chem [1923] have demonstrated a supplementary relation between the proteins of corn and rice bran Boas Fixen [1931 35] states that Osborne and Mendel considered that rice bran and barley supported growth better than did oats and maize According to West and Cruz [1933] rice bran is considered an excellent cattle food, being more nutritious than hydraulic copra cake wheat bran, gram and straight grade flour They further state that it has been estimated that thirty grms rice bran provide sufficient vitamin B to those susceptible to beriberi

According to various investigators—Suzuki, Yoshimura and Fugi [1909], Osborne and his co workers [1915] Jones and his co workers [1927]—the proteins of rice and rice bran include all important amino acids covering the requirements of maintenance and growth

Rice bran is also very rich in oil (about twenty per cent in the samples used in the experiment under reference) Winton and Winton [1933] in their work "The Structure and Composition of Foods" have cited from various authors the different kinds of oil present in rice bran and it would appear from the same that the oil mainly consists of palmitic (eighteen to twenty per cent), oleic (forty one to forty seven per cent), linolic acids (thirty to thirty seven per cent) and a fraction of other acids It has been shown by Burr [1930] that linolic acid and possibly other fatty acids are essential constituents of the diet and that the absence of such fatty acids leads to kidney degeneration, failure of reproduction and other disturbances

Taking all these facts into consideration rice bran would appear to be a feed of great promise especially in regard to organic nutrients Its mineral composition however is of very interesting nature It is unusually rich in phosphorus (over six per cent P_2O_5 in the sample used) Its magnesia content also is much greater (2 6 per cent) than many feeds but it is very poor in lime (only 0 2 per cent) Its lime phosphorus ratio (CaO P_2O_5) is about 1 32, and in this respect it is highly imbalanced Besides, the phosphorus in it is probably not in an assimilable form As will also appear from the results of experiment described below, these two are probably the main factors in the way of its unsatisfactory assimilation

In Bengal, the stuff is widely available and is sold at a cheap rate The cultivators and cartmen feed it to their animals Mr Gossip, Live stock Expert, Bengal, stated that at Ferozepur he had fed some three to three and a half seers per animal but the feeding was attended with severe loss of condition, even resulting in the death of three animals

The preliminary experiment conducted in Bengal has also given indication of unsatisfactory effects by its feeding Nine country bullocks were fed with *Aman* rice straw *ad lib*, and with it rice *kura* was fed at a certain proportion of live weight varying from 1250 grms to 2000 grms. per 1000 lbs The feeding lasted for about eighteen weeks commencing from the 15th January 1934 and terminating on the 20th May 1934

There are two aspects from which the efficiency of the feed can be judged from external appearance :—One is appetite as will be indicated from the rate of consumption and the other is loss or gain in live-weights. It may briefly be stated that except for the first two weeks the consumption of straw fell markedly. This ranged from twenty per cent to over fifty per cent on the basis of the consumption of the first and last weeks as can be judged from the following.

TABLE II

Kura fed per 1000 lbs. live-weight grms.	Animal No.	*Kura* fed grms.	Percentage fall in straw consumption 1st and last week per cent	Loss or gain in live-weight 1st and last week
1250	D_5	675	23·21	— 9·2
	D_8	650	30·60	— 9·6
1500	D_1	806	23·86	+3·4
	D_4	880	32·54	— 37·0
	D_9	924	32·55	— 19·2
1750	D_3	1,000	20·90	+2·6
	D_7	900	52·40	— 18·8
2000	D_2	1,180	19·62	+3·4
	D_6	1,208	29·62	— 12·4

It will be seen that the fall in the consumption of straw or the fluctuations in live-weight are hardly related either to each other or to the rate of *kura* fed under the four divisions. It shows that there was generally a marked disinclination for straw consumption and that the loss of weight was also equally marked in six out of nine animals while the nominal gain of the remaining three was at most of a stationary nature.

The cause of it might be associated with a deficiency or imbalance in energy supply, protein or mineral matter, either singly or in combination.

With respect to energy supply some deficiency was bound up with fall in the consumption of straw, but as the share of *kura* was generally consumed in full the actual deficiency was not very large. In fact, the total digestible nutrients and starch equivalents compare fairly well with the results of more balanced feeds as can be judged from Table III.

TABLF III

Kura per 1 000 lbs live weight	Anima No	*Aman* straw and rice *kura*			*Aus* straw and linseed cake		
		Total digestible nutrients Lbs	Starch equivalent Lbs	Nutritive ratio 1	Total digestible nutrients Lbs	Starch equivalent Lbs	Nutritive ratio 1
1250	D_5	6 888	4 540	32	7 131	4 841	12
	D_6	6 099	4 316	34	6 763	4 598	14
1500	D_1	6 570	4 634	25			
	D_4	6 624	4 179	28	7 469	5 300	15
	D_9	6 687	4 556	26	7 551	5 423	15
1750	D_3	6 135	4 308	25			
	D_7	5 982	4 142	25			
2000	D_2	6 256	4 070	22	6 792	4 902	14
	D_8	5 628	4 311	24	6 134	3 954	11

There was thus no serious deficiency in energy supply.

In the case of protein also the supply at any rate did not seem to be low ; the balance figures were also positive in the case of seven out of nine animals. But about two-thirds to three-fourths of the amount ingested passed as undigested material through the faeces. Naturally the share of digestible nitrogen falling to the lot of each was low (about eight to ten grms.) and this was reflected in the nutritive ratio which varied from 1 : 24 to 1 : 34. If rice protein had a better biological value as is seen from the results of various workers there was no reason why the assimilation should be poor. The disturbed condition in the animal cannot therefore be explained from either any deficiency in energy supply or unsuitability of rice protein. Such an inference could have had some justification if the mineral side had been better balanced. But it seems that in this respect rice bran possesses certain characteristics quite distinct from others. It has been already stated that rice bran is very poor in lime and unusually rich in phosphorus resulting in a wide ratio (1 : 32) between them. This will be naturally reflected in the feed as can be judged from Table IV.

TABLE IV

Intake of nutrients computed on 500 lb live weight

(Symbols (+ —) indicate whether the balance was positive or negative)

Kura per 1000 lb live weight	Animal No	*CaO*	*MgO*	*K_2O*	Na_2O	P_2O_5	*Cl_2*	Digested nitrogen	$\frac{CaO}{P_2O_5}$ 1	$\frac{CaO}{K_2O}$ 1	Nutritive ratio	Loss or gain in live weight 1st and last week
1250	D_5	18 227 −	27 387 +	74 688 +	17 210 +	38 843 −	19 364 −	9 196 +	2 13	4 10	32	−9 2
	D_8	17 458 −	26 924 −	71 868 +	17 102 +	38 906 −	19 218 −	7 835 +	2 23	4 10	34	−9 6
1500	D_1	18 024 +	29 516 +	74 950 +	16 999 +	44 446 +	18 900 −	11 233 +	2 46	4 17	25	+3 4
	D_4	16 231 −	27 413 +	64 927 +	16 845 +	42 833 −	19 424 +	9 957 +	2 64	4 00	28	−37 0
	D_6	16 795 −	29 112 +	70 599 +	14 058 +	45 465 +	19 609 −	10 781 +	2 71	4 [illegible]	28	−19 2
1750	D_2	16 090 −	30 805 +	65 771 −	17 293 −	51 655 +		10 538 +	3 02	4 08	25	+2 6
	D_7	15 394 −	30 104 +	66 384 +	15 839 −	50 169 +	17 296 −	10 377 +	3 26	4 31	25	−18 8
2000	D_3	14 207 −	32 227 +	59 876 −	16 525 +	58 282 +	17 179 −	11 598 +	4 10	4 20	22	+3 4
	D_9	15 282 −	33 153 +	63 700 −	17 041 +	58 914 +	17 951 −	9 624 +	3 86	4 17	[illegible]	−12 4

In this table the major facts are epitomised and the total intakes of different nutrients are set up with their positive or negative symbols indicating the results of balances. The results are also computed on the basis of 500-lb. live-weight to facilitate a better comparison.

It will be noted from this :—

(1) that lime supply was low (fourteen to eighteen grms.) and eight out of nine have recorded a negative balance,

(2) that phosphate ingestion has been very high (thirty-nine to fifty-nine grms.) but in spite of such heavy ingestion three out of nine have recorded a negative balance,

(3) that $CaO : P_2O_5$ ratio has varied from 1 : 2 to 1 : 4 and $CaO : K_2O$ ratio has been about 1 : 4,

(4) that like lime the chlorine balances have also been largely negative. The amount is slightly below the requirement,

(5) that magnesia ingestion also has been much higher (about $1\frac{1}{2}$ to double) as compared to the other combinations so far tested at Dacca (except Guinea grass) and

(6) that digested share of nitrogen was low.

It has been already stated under " The Lime and Phosphorus Requirement of Bengal Cattle" that under the condition of rice straw feeding positive balance could not be attained until the ingestion was about twenty-four grms. CaO per 500-lb. live-weight. Here the amount was less by about a quarter. This factor by itself would thus react on the normal metabolism.

The large ingestion of phosphorus might suggest as being another contributory cause. But it has been found by workers like Cox and Imboden [1936] that excess of phosphorus was better tolerated than excess of lime. It has been stated under " The Lime and Phosphorus Requirement of Bengal Cattle " that the Bengal experiments show that the P_2O_5 requirement of Bengal cattle is about ten grms. But in the case of feeding with rice *kura* positive balance could not be attained until the ingestion was about 43 grms. P_2O_5. Another striking feature was that in the three instances of negative balance, aside from the amount excreted through urine, more P_2O_5 was voided through faeces above than was provided in the feed.

The cause of poor utilization of P_2O_5 from rice bran is in all probability associated with the fact that the phosphorus compound in it is chiefly in the form of phytin which is not readily assimilable. Rather [1918] determined the nature of phosphorus compounds in rice products and found that out of total phosphorus eighty-seven per cent existed as inosite penta phosphoric acid and nineteen per cent in inorganic combination in rice bran, while in rice polish the percentages were ninety-three per cent and ten per cent respectively. It will be seen that the inorganic portion is very low and it is the paucity of this which is probably mainly responsible for low assimilation. These aspects have been dealt with in greater

detail by Carbery, Chatterjee and Talapatra [1937] in their studies on mineral assimilations Possibly, in the feeding experiments under review the inorganic portion reached the level of requirement at about the stage of 43 grms ingestion of P_2O_5 (Table IV) At the same time it shows the very large proportion of phosphorus which is practically being wasted, and this point is deserving of close attention

Reverting again to the behaviour of rice *kura* it may be stated that, apart from its rather peculiar complex of mineral combination, there are evidences suggesting that cereal diets appear to have deleterious effect on calcification Holst [1927] reported a ricket producing factor from oats which could be extracted with 0 5 per cent hydrochloric acid and Mirvish [1929, 1930] reported that when a dilute hydrochloric acid extract of oats was injected into animals it produced a marked fall in the blood calcium Low and Steenbock [1936] found that the inorganic P content of the variously treated samples of maize bore a direct relation to the anti rachitic effectiveness of the ration and an inverse relation to the phytin content, and that the hydrolysis of phytin by hydrochloric acid improved it to the extent of hydrolysis

It is just possible that in the present experiment all these factors combined together to bring in a condition of physiological disturbance which was reflected in a low nitrogen assimilation, the negative chlorine balance and so forth The loss of appetite as indicated from the decreased consumption of roughage was another manifestation of same

We are thus faced with a problem of great economic and academic interest. On one side there is a large supply of a cheap and easily available cattle food which has apparently all the elements of nutrition, on the other side the feeding is followed by conditions which suggest the possibility of a complex combination It offers an interesting field for study

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GENETIC IMPROVEMENT OF WHEAT IN BOMBAY

I BANSIPALLI—808

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INTRODUCTION

WHEAT is one of the important staple crops in the province of Bombay It occupied nearly 17,60 000 acres in 1934 35 Of this acreage the Deccan claims nearly 60 per cent, Karnatak 30 per cent and the remaining area is mostly concentrated in the Bhal tract of Gujarat (Fig 1)

Over ninety per cent of the crop is grown dry, *i e*, in the *rabi* season The crop is sown from October to November and harvested from February to March The most extensively grown varieties belong to the species, *Triticum durum* Desf In the Deccan the local wheat is known as Bansi or Pivala

The genetic improvement of wheat has been in progress since 1918 The results of some improved strains have been published in Bulletin 166 of the Department, Nazareth [1931]

The present paper summarizes the behaviour of a new strain, Bansipalli 808

HISTORY OF THE STRAIN

Bansipalli 808 is a synthetic strain, having been evolved from a cross between Bansi 168 and Kala Khaphi 568 The former is a pureline selection from the local Bansi wheat It was originally selected in 1919 by Chibber, who was the then Plant Breeding Expert to the Government of Bombay, Bhide [1920 21] Compared to local, Bansi 168 is an early wheat, and has attractive yellow grains and lustre The plant has smooth brown glumes and awns It is now a standard strain in West Khandesh The other parent, Kala Khaphi 568 is derived from a natural cross The original plant was found by Chibber in a crop of ordinary Khaphi and attracted attention due to its black awns The plant

*Deceased

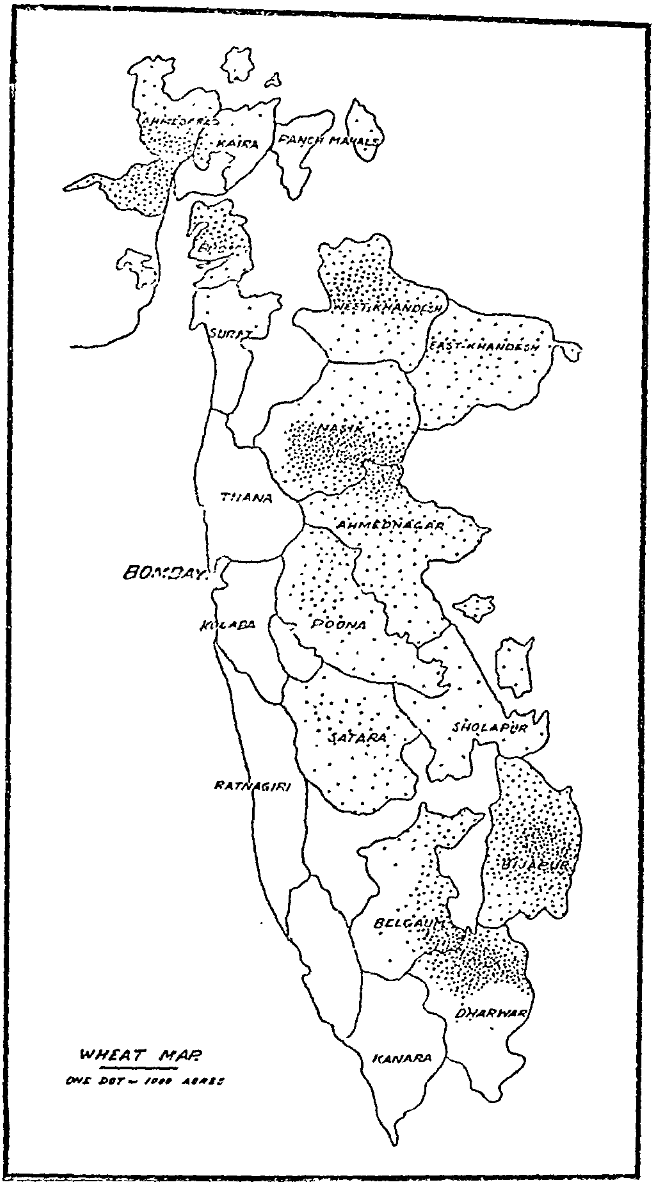


FIG 1.

Distribution of wheat acreage in Bombay

proved heterozygous for a number of characters and ultimately a strain, believed then to be resistant to black stem rust, was isolated by Bhide and named Kala-Khapli-568. It has been proved that besides Khapli, the other parent of Kala-Khapli-568 must have been Baxi [Kadam, 1936,2].

With a view to producing rust resistant varieties Bhide crossed the two varieties in 1923 24 Until the year 1929 30 the hybrid material was being purified Ultimately four selections were secured for final trials on the experimental plots and in the districts These were named 806 807, 808 and 809, [Kadam, 1929-30] These strains and some pure Bansi selections were compared in the various major zones of the province until 1935 Out of these, Bansipalli 808 emerged as the most successful wheat

Botanical and agronomic characters

Bansipalli 808 is an early maturing variety It flowers from sixty to sixty five days after sowing and ripens in ninety to ninety five days The plant of Bansipalli 808 is short in stature and is conspicuous in the field due to its broad leaves It has glabrous white glumes and white awns The grain is large, light yellow and lustrous It is characterized by abruptly pointed ends (Plate XXV)

Bansipalli 808 was closely studied during the years 1933 34 35 The data on various characters are summarized, along with the local, in Table I

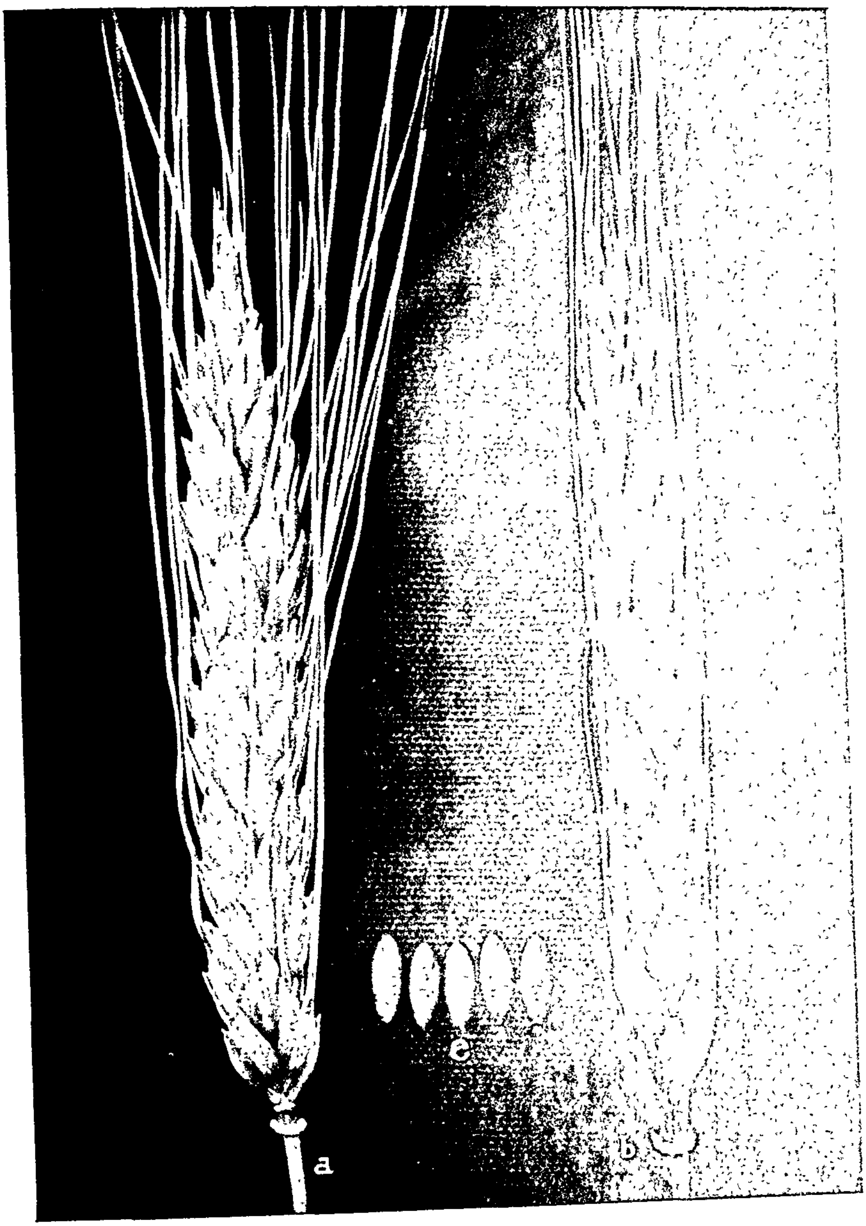
TABLE I

Botanical and Agronomic characters of local Bansi and Bansipalli 808

No	Characters	Year	Local			808		
			Range	Mode	Mean	Range	Mode	Mean
1	Days from sowing to heading.	1933 34	64 —79	75	72 6± 41*	54—77	59	60 3± 59
		1934 35	65—76	71	70 7± 22	56—73	63	61 0± 33
		1935 36	69—82	75	76 0± 41	60—73	63	65 1± 42
2	Tillers per plant	1933 34	1—7	3	3 20± 15	1—10	4	4 18± 31
		1934 35	1—14	6	6 04± 24	1—15	7	6 40± 32
		1935 36	1—26	10	8 40± 77	1—24	10	9 00± 73
3	Length of main spike in cms	1933 34	4 1—10 0	8 0	7 4± 11	5 1—10 0	7 0	7 [illegible]± 13
		1934 35	6 5—10 5	9 0	8 6± 08	4 5—10 5	8 0	[illegible] 6± 09
		1935 36	5 1—11 0	9 0	8 6± 17	3 1—10 0	9 0	8 6± 14
4	Spikelets on the main spike	1933 34	10—17	15	13 0± 18	8—15	13	11 7± 19
		1934 35	10—21	10	17 6± 17	9—18	13	13 2± 14
		1935 36	8—19	16	14 7± 40	7—18	14	13 9± 23
5	Density of the main ear and in cms	1933 34	0 45—0 [illegible]9	0 53	0 53±0 003	0 48—0 74	0 6[illegible]	0 60±0 006
		1934 35	0 43—0 64	0 50	0 49±0 003	0 40—0 67	0 62	0 58±0 004
		1935 36	0 42—0 65	0 53	0 56±0 007	0 48—0 68	0 59	0 60±0 00[illegible]
6	Grains per grm	1933 34	19—30	2[illegible]	23 4± 28	17—28	22	22 2± 33
		1934 35	18—27	21	22 5± 77	18—30	22	23 4± 26
		1935-36	17—28	21 [illegible]2 & 24	22 7± 41	18—30	19 & 20	20 6± 95

* Standard errors

BANSIPALLI — 808



(a) Front view of the panicle, (b) Side view, (c) Grains.

No.	Characters	Year	Local			808		
			Range	Mode	Mean	Range	Mode	Mean
7	Length of grain in mms.	1933-34	6·7—8·4	7·8	7·8±·03	7·3—9·0	8·1	8·2±·04
		1934-35	7·1—8·6	8·1	7·9±·03	7·4—8·9	8·4	8·2±·03
		1935-36	7·2—8·6	7·7 & 8·0	8·0±·71	8·1—9·5	8·6	8·8±·54
8	Breadth of grain in mms.	1933-34	2·0—3·7	3·1	3·0±·03	2·0—3·4	3·1	2·9±·03
		1934-35	2·4—3·6	3·4	3·2±·02	2·1—3·6	3·1	2·9±·03
		1935-36	2·3—3·7	3·1	3·2±·41	2·6—3·4	3·1	3·2±·09
9	Yield of grain per plant in grms.	1933-34	2·5—10·0	2·5 & 5·0	4·2±·61	2·5—15·0	2·5	5·6±·47
		1934-35	2·5—32·5	7·5	9·7±·37	2·5—32·5	5·0	10·4±·62
		1935-36	2·5—37·5	10·0	12·0±1·10	2·5—47·5	15·0	14·5±1·4
10	Weight of 1000 grains in grms.	1936-37	36·9—40·9	...	39·2±0·39	45·4—48·4	...	46·9±0·3
11	Bushel weight in lbs.*	1936-37	66·32—67·73	...	67·17±0·178	65·75—67·73	...	66·6±0·16

It will be seen from the above table that the improved strain is earlier to local by ten to fifteen days. In tillering and yield it is slightly better than the local variety. The grain of Bansipalli-808 is larger and much heavier than that of the local, although it is not as broad as that of the latter. The local variety has slightly more number of spikelets and has a denser panicle than the synthetic wheat.

It is interesting to note that although the grain of Bansipalli-808 is longer and heavier than the local Bansi, the bushel weight is lower than the local. This is due to the shape of the grain of the improved wheat. The grains of the new wheat are long and consequently they do not fill up the measure so compactly as those of the local, which has short plump grains. As a result there are fewer grains of Bansipalli-808 in a half-pint measure than that of the local.*

Experiments on the farm

During the years 1931-32 to 1934-35 Bansipalli-808 was compared in random replications along with a number of other improved strains and with the local Bansi at the Cereal Breeding Station, Niphad.

In the year 1931-32 Bansipalli-808 was replicated six times on one *guntha* plots with Bansipalli strains 806, 807, 809, 907, Pusa-4 and local Bansi. The experiment indicated significant strain differences. The Bansipalli strain 809 and the local proved significantly superior to the general mean. The strain 907 and Pusa-4 were significantly lower in yield, while Bansipalli-808 was slightly below the general mean. [Kadam, 1931-32].

* Bushel weight was determined from a half-pint measure.

In the year 1932 33 various improved strains were compared in Latin square on one *guntha* plots These were the Bansi strains, 103 162, 168 and 224, the Bansipalli strains 808 and 809 Pusa 4 and the local Bansi Due to abundant moisture the crop was excellent and the yields were very high None of the strains however proved significantly superior to the general mean of the experiment Bansipalli 808 however, gave better yield than the local, which was one of the low yielders [Kadam, 1932 33]

The same set of strains as in the previous year was compared in a Latin square in 1933 34 The crop of the season was poor, due to a number of factors The experiment showed significant yield differences The Bansipalli strain 808 and 809 and Pusa 4 being significantly inferior, in the order stated, to the general mean, [Kadam, 1933 34]

Out of the three years only once Bansipalli 808 gave better yield than the local Considering the average yields the local exceeded Bansipalli 808 by seventy five and eighty nine lbs per acre in 1931 32 and 1933 34 respectively, while the latter gave more yield by 45 lbs over the former in 1932 33 The general averages for the three years of local and Bansipalli 808 were 733 lbs and 693 lbs respectively the former out yielding by 40 lbs only

District trials

Although Bansipalli 808 was not better in yield to local when compared on the farm its earliness and better grain characters made it desirable to under take trials in the districts From 1931 32 to 1935 36 Bansipalli 808 was compared with the local wheat in the Nasik district of the North Central division and at various places in the Southern division The comparisons in these divisions are now discontinued and the strain is now a standard in both the tracts Since 1935 36 yield trials of Bansi 168 Bansipalli 808 and Bansipalli 809 have been recommenced in Ahmednagar district Trials previous to 1935 36 season were taken but reliable results could not be obtained due to frequent changes in the personnel of the Agricultural Overseer Nagar The two years' trials in 1935 36 and 1936 37, have, however, unquestionably demonstrated the superiority of Bansipalli 808 over the local wheat and the companion strain The district results for each tract are given below separately

Trials in the Nasik district—During the five years 1931 35, Bansipalli 808 was compared twenty nine times with the local Bansi wheat in various talukas of the Nasik district [Kadam 1931 35] The results are summarized taluka by taluka in Table II

TABLE II

*Village trials of Bansipalli-808 conducted in the district of Nasik during the years 1931-32 to 1935-36**

Serial No.	Place	Taluka	Year	Yield per acre in lbs.		Increase or decrease over local in per cent
				Bansipalli-808	Local	
1	Vadgaon	Sinnar	1931-32	800	560	42·86
2	Lonarwadi	Do.	1932-33	550	No	comparison
3	Ditto	Do.	1932-33	506	425	19·06
4	Khopdi	Do.	1932-33	400	360	11·11
5	Dharangaon	Do.	1933-34	595	520	14·42
6	Pangari	Do.	1934-35	700	680	2·94
7	Ditto	Do.	1934-35	600	620	—3·23
8	Marhal	Do.	1934-35	800	760	5·26
9	Khopdi	Do.	1935-36	600	580	3·45
10	Kirsavli	Do.	1935-36	500	460	8·69
11	Khadavli	Do.	1935-36	450	400	12·50
	Averages	..	..	591·00	536·50	10·16
12	Ambevani	Dindori	1931-32	960	480	100·00
13	Ditto	Do.	1932-33	560	560	Equal
14	Ditto	Do.	1932-33	540	612	—11·76
15	Khedgaon	Do.	1935-36	320	320	Equal
	Averages	..	..	595·00	493·00	20·69
16	Pimpalgaon	Niphad	1931-32	720	480	50·00
17	Ditto	Do.	1932-33	720	880	—18·18
18	Ditto	Do.	1932-33	420	448	—6·25
19	Vinchur	Do.	1933-34	640	560	14·28
20	Pimpalgaon	Do.	1933-34	560	600	—6·66
21	Ravlas	Do.	1933-34	680	672	1·20
22	Bharwas	Do.	1934-35	560	560	Equal
23	Chanduri	Do.	1935-36	492	484	1·65
24	Shervade	Do.	1935-36	264	264	Equal
	Averages	..	..	562·00	550·00	2·18
25	Nasik	Nasik	1934-35	480	400	20·00
26	Gangapur	Do.	1935-36	444	428	3·74
	Averages	..	..	462·00	414·00	11·59
27	Kavithkhede	Nandgaon	1934-35	240	240	Equal
28	Bolthan	Do.	1934-35	756	711	6·33
29	Ditto	Do.	1934-35	300	242	24·00
30	Rohile	Do.	1934-35	319	272	18·00
	Averages	..	..	404·00	366·00	10·38
	General averages	..	..	523·00	472·00	10·80

* The writers are indebted to Mr. C. S. Patel, formerly Deputy Director, for undertaking trials and to Mr. K. V. Joshi for continuing the same in the North-Central division. They also greatly appreciate the willing help rendered by the district officers.

It will be seen from the above table that out of twenty-nine comparisons Bansipalli 808 shows higher yields nineteen times, is equal to local in five cases and gives lower yields in five cases only The general average increase of Bansipalli 808 over the local per acre is nearly 11 per cent

Trials in the Southern division.—The two Bansipalli strains, 808 and 809 and Bansi 103 were given trials for a number of years in the Southern division Of these, Bansi 103, although higher yielding than the local, proved unsuitable due to its late maturity Bansipalli 809 was not as good as the sister strain 808, [Kadam, 1931 35] The results of Bansipalli 808 and of the local only are, therefore, shown in Table III

TABLE III

*Village trials of Bansipalli 808 conducted in the districts of Dharwar, Bijapur and Belgaum during the years 1931 32 to 1935 36**

Serial No	Place	Taluka	District	Year	Yield per acre in lbs		Increase or decrease over local in per cent
					808	Local	
1	Dharwar Farm	Dharwar	Dharwar	1931 32	164	11 56	Badly rusted
2	Aigali	Athani	Belgaum	1932 33	768	480 00	60 00
3	Honganhalli	Bijapur	Bijapur	1932 33	480	473 00	1 50
4	Sirur	Bagalkot	Bijapur	1934 35	148	140 00	5 71
5	Galgali	Bilgi (Peta)	Bijapur	1934 35	320	280 00	14 29
6	Shedbal	Athani	Belgaum	1935 36	192	144 00	33 33
7	Musuguppi	Gokak	Belgaum	1935 36	148	119 00	24 37
8	Ulligeri	Saundatti	Belgaum	1935 36	234	223 00	4 93
9	Inamhongal	Saundatti	Belgaum	1935 36	260	200 00	30 00
10	Murgod	Saundatti	Belgaum	1935 36	512	488 00	4 91
11	Basapur	Navalgund	Dharwar	1935 36	576	256 00	125 00
12	Bijapur	Bijapur	Bijapur	1935 36	453	304 00	49 01
	Averages				372	282 00	31 90

* Thanks are due to Rao Bahadur S S Salimath Deputy Director, for undertaking trials in the Southern division and to his district officers for supervising the field experiments

The trials in 1931 32 and in 1933 34 were vitiated by a heavy rust attack The grain in the former year was so shrivelled that it was unfit for human use The yields for 1933 34 are not available

It will be seen that in all cases the improved strain has given more yield than the local variety The increases in outturn range from 1 5 per cent to as much as 125 per cent The average increase in yield of Bansipalli 808 is nearly 32 per cent

Trials in the Ahmednagar district.—Bansi-168, Bansipalli-808 and Bansipalli-809 were compared with the local Sudhe wheat during the years, 1935-36 and 1936-37. In the former season comparisons were made only at four places. As the improved strains appeared promising the comparisons were extended to ten places in 1936-37. Of the three strains, Bansipalli-808 has proved the best due to its earliness, large and lustrous grains and good yields, [Kadam, 1935-37]. In view of this the behaviour of Bansi-168 and Bansipalli-809 is not shown in the following table as it has been definitely decided to withdraw them from trials. The yield behaviour of Bansipalli-808 and local Sudhe wheat is shown in Table IV.

TABLE IV

Village trials of Bansipalli-808 conducted in the district of Ahmednagar during the years 1935-36 and 1936-37 (a)

Serial No.	Place	Taluka	Year	Yield per acre in lbs.		Increase or decrease over local in per cent
				808	Local	
1	Kanhur . .	Parner .	1935-36	560	316	77·21
2	Nagar . .	Nagar .	1935-36	660	319 (Baxi)	106·89
3	Bhadgaon .	Shevgaon .	1935-36	613	580 (Baxi)	5·69
4	Shrigonda .	Shrigonda	1935-36	384	220	74·54
5	Gargundi . .	Parner .	1936-37	345	*120	187·50
6	Gargundi . .	Parner .	1936-37	450	*119	278·15
7	Kanhur . .	Parner .	1936-37	365	*110	231·82
8	Kanhur . .	Parner .	1936-37	375	†25	..
9	Ourangpur .	Akola .	1936-37	616	580	6·21
10	Thugaon . .	Akola .	1936-37	528	396	33·33
11	Ghodegaon .	Newase .	1936-37	500	320	56·25
12	Khadke . .	Newase .	1936-37	400	150	166·66
13	Newase . .	Newase .	1936-37	520	360	44·44
14	Tarawdi . .	Newase .	1936-37	360	200	80·00
	Averages .	..	..	477	272	75·00

(a) We are beholden to Mr. V.V. Gadgil, Deputy Director, for conducting trials in the South-Central division. Our thanks are also due to Mr. R. D. Khandekar, Agricultural Overseer, Ahmednagar, for personally supervising the trials.

* Partial failure of the crop due to low moisture.

† Complete failure of the crop due to low moisture.

During 1935-36 Bansipalli-808 was compared against Baxi and Sudhe varieties under dry conditions. The former is an irrigated variety and is very late com-

the seedling stage to the two forms XXI and LXXV.* This is not surprising since K. K.-568 is itself a product of a natural cross between the true Khapli and Baxi wheat, the latter being susceptible to all these forms of rust. Bansipalli-808 has, however, inherited seedling resistance to forms XXI and LXXV, but is susceptible to other forms. Therefore, it cannot be regarded as a resistant wheat. If sown early, it may, however, escape rust as it matures ten to fifteen days earlier than the local wheat.

4. *Hardness of grain.*—In the Southern division of the province, the grain of Bansipalli-808 is not considered to be as hard as that of the local red wheat. The grain is unsuitable for making certain local dishes, but for *chapatees* it is preferred to the local variety.

5. *Injury by frost.*—In the central portion of Nasik district frost sometimes prevails in mid-January. In these parts wheat is sown late. Bansipalli-808, being early, comes in dough stage much earlier than does the local. The periods of grain formation of the improved wheat and of frost coincide with the result that the development of the grain is affected. It is, therefore, necessary to adjust the sowing of Bansipalli-808 in this part of Nasik in such a way that the grain formation period will occur either later or sufficiently earlier to escape damage from frost. Studies in growing Bansipalli-808 at various periods from mid-October upto late in November have shown that no critical differences in yields of different periods of sowings occur, indicating possibilities of adjusting time of sowing properly. In fact the value of the improved wheat in central Nasik has been realized both by the farmers and by the propaganda staff of the North-Central division as evidenced by a demonstration of Bansipalli-808 organized at Krishnagaon, Dindori taluka, during mid-January 1937.†

Discussion

The problem of replacing the local wheats by better varieties in the Nasik and Ahmednagar districts and Karnatak has been partly solved by the introduction of Bansipalli-808 in these regions. This wheat is not only a better yielder, but fetches higher prices due to superior grain characters over the local wheats. In the Deccan districts an early wheat is a prime necessity and in this respect Bansipalli-808 admirably suits the requirement. If sown in time—about mid-October—it ripens before the advent of cold and black stem rust. But when sown late it suffers from frost. This is usually the case in the Central part of Nasik. The problem, therefore, is to evolve a frost-resistant variety which would be suitable to this portion of Nasik. This can be achieved by hybridization with frost-resistant durums and selecting suitable hardy types. The task, however, is very

* So far six forms of stem rust of wheat have been found in India. Seedling reaction of our wheats to these forms was tested by Dr. K. C. Mehta, Agra, to whom our thanks are due.

† *Dnyanprakash*, February 21, 1937.

difficult if not impossible in the absence of facilities to determine frost resistant quality in hybrid material In view of this, the only alternative is to conduct trials of new strains in the proper tract and by experience to select a suitable variety

Another pressing need of the Nasik district and indeed of most of the wheat growing tracts of the province is rust resistant varieties In this respect none of the cultivated wheats except Khapli is resistant to black stem rust The problem is somewhat complicated due to the existence of various physiological races of the rust Fortunately the importance of the problem is now generally recognized and there are indications that we will soon possess necessary equipment to undertake breeding of rust resistant varieties

The acceptance of Bansipalli 808 in Karnatak is half hearted, although the strain is undoubtedly high yielding But high yield is only one of the requirements the local farmer desires there In addition a strain must be early even earlier, than the local and should possess very hard flinty grains In these respects Bansipalli 808 does not come up to expectation The problem of introducing earlier wheats and yet better yielding may be solved as we have now such types which may prove suitable to Karnatak The Deccan Bansi however is not considered as hard in grain as the local red wheat of Karnatak and this demand can only be met by improving the local red wheat This will be the best solution since an improved red wheat will serve specific requirements which a white-grained wheat would not Improved strains of both white and red wheats would act as complementary and would meet most of the requirements of the wheat farmers of Karnatak

The Ahmednagar district is a tract of precarious rainfall Early ripening character therefore greatly enhances the value of an improved crop strain Bansipalli 808 in this respect has amply proved worthy, even in so short a period as two seasons The new variety can now be spread confidently as a dry wheat

Each of the two Deccan districts Nasik and Ahmednagar and the two wheat districts of Karnatak Bijapur and Dharwar claims more or less twelve to sixteen per cent of the total area under wheat in the province of Bombay Together, they represent nearly fifty five to sixty per cent of the total area, or 987,178 acres Bansipalli 808 has thus vast possibilities of expansion

SUMMARY

1 A new wheat Bansipalli 808, is described It was evolved from a cross between Bansi 168 and Kala Khapli 568

2 The synthetic wheat is earlier by ten to fifteen days to the local wheat Its grain is larger and has a more attractive yellow colour than the local Bansipalli 808 has glabrous white glumes and awns

3. The new wheat has proved suitable to Nasik district, especially to the southern and eastern portions and to the wheat tract of Karnatak. It is also suitable to Ahmednagar district.

4. Bansipalli-808 is slightly more difficult to thresh than the local wheat. It is likewise susceptible to black stem rust. Its grain is not as hard as the local red wheat of Karnatak. In the central portion of Nasik it is said to be injured by frost more than the local wheat.

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PROBLEMS OF POTATO BREEDING IN INDIA

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PART I

PART I

INTRODUCTION

THE principal aim in potato breeding is the improvement of its yield. Yield is a very complex character, depending upon the interaction between many factors within the plant and its environment, the latter controlled to no small extent by agricultural practice. A large share of the reduction in yield which commonly occurs is caused by one or other of the many diseases to which the potato plant is susceptible. For example the annual loss in Europe due to Late Blight (*Phytophthora infestans*) alone is about ten to fifteen per cent of the crop. Virus diseases are also very destructive whilst considerable loss to the potato crop is caused by wart disease (a disease which is not known in India), potato scab, *Rhizoctonia* wilt, frost, drought and insect pests.

An admirable account of the potato in its early home and its introduction into Europe has been given by Salaman [1937, 1]. In the early history of potato cultivation in Europe much emphasis was placed on cultural practices. Breeding was confined to the use of parental varieties already cultivated in Europe and North America. In the present century, stimulated by the Russian and other expeditions to South America—the original home of the potato—a much wider

range of material has become available providing a remarkable impetus to research on the breeding, genetics and cytology of the potato. The early stock of European potatoes was derived from a restricted source consisting of a few varieties of *Solanum tuberosum*, and did not represent all the genetic possibilities of the potato. According to Bukasov [1932] a limit in the improvement of the potato had been reached; in the production of new varieties all the possible combinations of the same old parents had been tried and "a *cul-de-sac* had been reached with many problems still unsolved, such as blight and virus diseases." Thus, there was a need for a wider range of new materials to meet the greatly diversified demands of breeding for different regions: such a richness of material could be best found in the home or centre of origin of the potato. Accordingly, the Russian expeditions proceeded to America and searched the countries of Mexico, Guatemala, Columbia, Equador, Peru, Bolivia, Chile and Argentina, bringing home more than a thousand specimens of tuber-bearing solanums. The discovery of this wealth of new material has thus opened up new possibilities for the improvement of the cultivated potato.

The potato material collected by the various expeditions from Russia, Germany, the United States and Sweden comprises a large number of widely different wild and cultivated varieties. Species with different chromosome numbers, *viz.*, 2n=24, 2n=36, 2n=48, 2n=60 and 2n=72 have been discovered. The European and North American cultivated potatoes all belong to the 2n=48 class, but the existence of various wild species with other chromosome counts was known long before the Russian expeditions.

The new stocks are distinguished by many other characters such as those with dominant colour in tuber and flower, different ranges of photoperiodism and adaptability, differences in resistance to low temperature and, above all, differences in resistance to the assaults of blight.

The South American species, *Solanum Rybinii*, is said to be possessed of resistance to virus diseases to which all the domestic potato varieties are susceptible, with the exception of the seedling variety 41956 produced in the United States which exhibits a resistance against the X virus. Types with high as well as low contents of protein and starch, short and long rest period, and several other useful qualities, are also included in the collections. The species *S. phureja* is said to be capable of growing in hot valleys at much lower altitudes than the other species and is one of the few potatoes in which tuber formation is not impeded by hot, humid, sub-tropical conditions. The various forms of *S. andigenum* which exhibit a wide range of adaptability also merit serious investigation.

With the use of the Central and South American materials considerable success has already been achieved in the breeding of potatoes for resistance to Late Blight. Dr. Salaman of Cambridge University, who had worked on the genetics and breeding of potatoes for many years, has recently obtained very promising

results from hybrids with *S demissum* [Salaman 1934 1937 2] A good deal of work has also been done in this direction at the Institute of Plant Breeding at Muncheberg (Germany) and by Professor Reddick at Cornell [1934]

In Russia, Bukasov [1936] reports hopeful results in the use of the new material in breeding for increased productivity

Potato breeding in India

(i) *Historical*

According to Watt [1908] the first mention of the potato in India occurs in Terry's account of the banquet at Ajmer given by Asaph Chan to Sir Thomas Roe in 1615 and Fryer in 1675 described the gardens of Surat and the Karnatal as containing among other vegetables brinjals (*Solanum Melongena*) and potatoes

To day the potato may be said to be cultivated to a greater or lesser extent in all parts of India both in the plains and in the hill up to an altitude of about 9 000 feet In the plains the potatoes are grown mainly in the countryside near the cities where there is a ready market in the hills the cultivation is more extensive such as on the Khasi and Garo Hills and the Himalayas at Darjeeling in Nepal Garhwal Kumaon Simla Kangra Kulu and Kashmir Again on the tableland and on the lower hills of the central and southern tracts of India extensive cultivation of potatoes occurs the produce being largely exported to the plains

Although definite figures of potato production in the various provinces and States in India are not yet available, there is no doubt that the potato has already established itself as an important crop In some parts of India it is often the only vegetable available to the poorer classes for the greater part of the year the crop is used almost entirely for human consumption.

(ii) *The problems in India*

Disease —The problems of potato breeding in India are very similar to those of Europe and America In the hills where the potato essentially a plant of temperate climes, is extensively cultivated Late Blight is liable to destroy the crop In the plains the crop is generally free from this disease as the high summer temperature kills the fungus if, however, potatoes are imported from the hills late in the year and sown when lower temperatures prevail epidemics of Late Blight may occur Early Blight due to *Alternaria solani* is common both in the hills and the plains Virus diseases especially those of leaf roll and mosaic common in the hills and the plains, are particularly widespread in the latter particularly in those districts where the seed is not regularly renewed from outside Wilt diseases and ring disease (*Bacterium solanacearum*) also cause much loss Wart disease fortunately does not occur in India

While in respect of diseases of the growing plant the problems in India are similar to those of foreign countries there is the added complication of the extensive

Quality and yield—As potatoes are mainly consumed in the form of curries etc the question of table quality does not loom so large in India as in Europe

The yield problem, however, is a very prominent one As a rule the average yield in India falls far short of that in Europe and America This is no doubt in great measure due to the high incidence of diseases lack of adequate manuring and perhaps the want of varieties really suited to the conditions obtaining in this country It should be remembered that all the varieties under cultivation in India have been imported and were evolved primarily to suit the conditions of the country in which they were bred This problem therefore merits close attention

(iii) *Material available for breeding*

The potatoes at present commonly cultivated in India are either imported European and North American varieties *e g* Up to date Great Scot Kerr s Pink etc or the so called *desi* (country) varieties The latter are doubtless imported varieties of which the original names have been lost and which have become acclimatised It is unlikely that locally raised seedlings have played any part in this as most of the cultivated varieties are partially or completely sterile and work on potato breeding in India has been negligible The *desi* varieties (Patna White Cola etc) may form good material for crossing with the new imported species as they represent varieties which have stood the test of time

At the Imperial Agricultural Research Institute and its Potato Breeding Sub station at Simla a large number of samples of potatoes collected from all parts of India with the help of the Directors of Agriculture of the provinces has been under study with a view to determining how many distinct varieties are cultivated and which of these are useful for breeding Material of the new South American and Central American species has also been received thanks to the courtesy of agricultural botanists in Britain America Germany and Russia Special mention must be made of Dr P S Hudson of the Imperial Bureau of Plant Genetics and Dr R N Salaman of the Potato Virus Research Institute Cambridge who have shown particular interest in the work and have rendered valuable assistance in procuring potato material The following species are under study at Simla •

S andigenum

S Antipoviczii

S aracc papa

S Caldasii

S Candelarianum

S chacoense

S Commersonii

S curtilobum

S. demissum

S. edinense

S. Fendleri

S. goniocalyx

S. Jamesii

S. leptostigma

S. Maglia

S. neoantipoviczii

S. otites

S. polyadenium

S. phureja

S. stenotomum

S. subtilius

S. tuberosum (from Chile)

Tuber and seed material of hybrids between *S. tuberosum* and other species (especially *S. andigenum*) has also been received. Until this material is multiplied it is not possible to undertake tests of resistance to diseases, etc. Such tests, however, will before long be carried out with the co-operation of the Mycological Section of the Imeprial Agricultural Research Institute.

(iv) *Methods of breeding*

For the production of new varieties it is necessary to raise plants from true seed because, except for the rare cases of somatic or bud mutations, plants propagated vegetatively remain true to type. The common cultivated potato being a highly heterozygous plant, a considerable diversity of types may be obtained merely by sowing its selfed seed, and this diversity is of course further increased by hybridization with other species thus providing the breeder with ample material to select from. As the potato is a vegetatively propagated plant, once a desirable seedling is secured it can be multiplied immediately for distribution.

Intensive breeding work with the common cultivated potato (*Solanum tuberosum*) has long been in progress in Europe and America and all the varieties in use have been produced from seeds obtained by crossing or selfing existing varieties. As already mentioned, a stage has been reached at which no further radical improvement can be expected by these methods. With the discovery in South America of a large number of both cultivated and wild species the outlook is altered. In the words of Bukasov [1936] the new potato species " open new horizons and present new problems. " Apart from the well-known difficulties

attending cross fertilization due to partial or complete male sterility in numerous varieties of potato many of the new species differ from the commercial potato in the number of their chromosomes Again, the desirable characters in them *e g*, blight resistance, may be linked with undesirable characters such as very long stolons deep eyes and fantastic colouring In order to transfer the few desirable characters from these species to the commercial potato varieties while retaining the properties of the latter it may be necessary to repeatedly back cross to the latter This is possibly not so necessary with a cultivated species such as *S andigenum* which approaches *S tuberosum* in many of its characters and indeed possesses the same number of chromosomes, with species such as *S demissum* *S Antipoviczii*, etc however, back crossing appears to be indispensable

It has also been suggested that the methods employed in breeding maize in America, *i e* in breeding to eliminate deleterious recessive characters, followed by intercrossing of the best inbred strains may be applied to the potato [Robb, 1934]

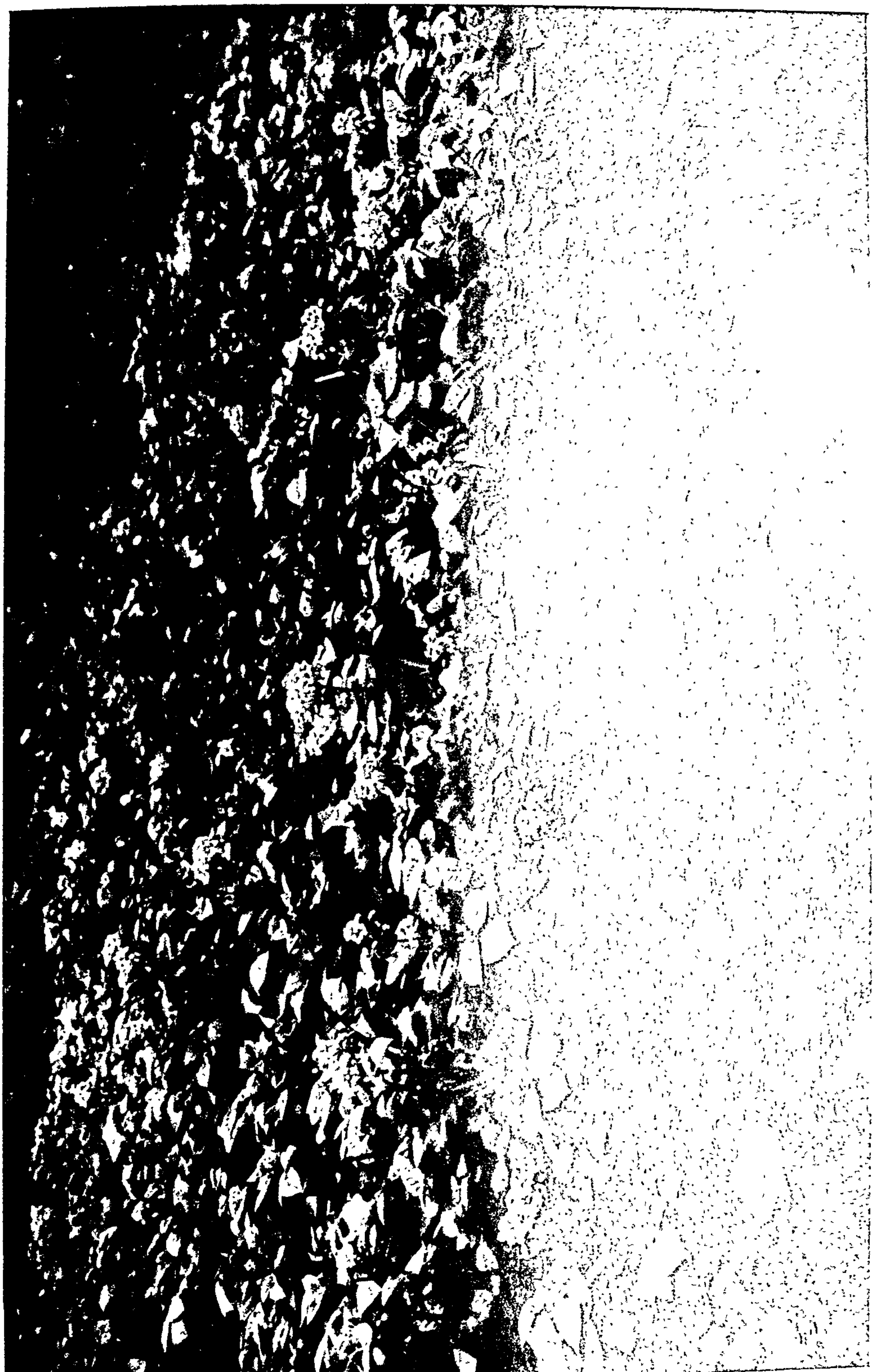
PART II

PRESENT POSITION OF POTATO BREEDING IN INDIA

Little actual potato breeding has so far been carried out in India, the activities of the various Agricultural Departments having been mainly restricted to the testing of varieties imported from abroad Occasionally attempt has been made to raise new varieties from seeds but apparently without much success

Potato breeding in India was taken up in earnest when two potato schemes financed by the Imperial Council of Agricultural Research came into operation in 1934 and 1935 respectively The Madras Potato Scheme has for its object the production of varieties suitable for local conditions The Potato Breeding Scheme for Northern India has a comprehensive programme embracing the whole of Northern India and provides a Sub station in the hills to work in co operation with the Botanical Section of the Imperial Agricultural Research Institute

In this connection it may be mentioned that as a rule potatoes rarely flower or form berries on the plains of India For example, out of 122 cultures grown at Pusa in 1934 35 from samples of tubers received from different parts of India, only thirteen stocks produced flowers and only three formed berries One variety, at present called "Pusa White" for convenience, however, showed fairly high flower and berry production A low temperature with high humidity is generally considered to be conducive to abundant berry production, conditions rarely fulfilled in the plains In the hills, however, both flower and berry production are often satisfactory (Plates XXVI and XXVII) In this connection it may be mentioned that an experiment was carried out in the summer of 1935 to determine the most suitable site in the hills of North India for a potato breeding station A standard set of about twenty varieties was grown at the following centres and



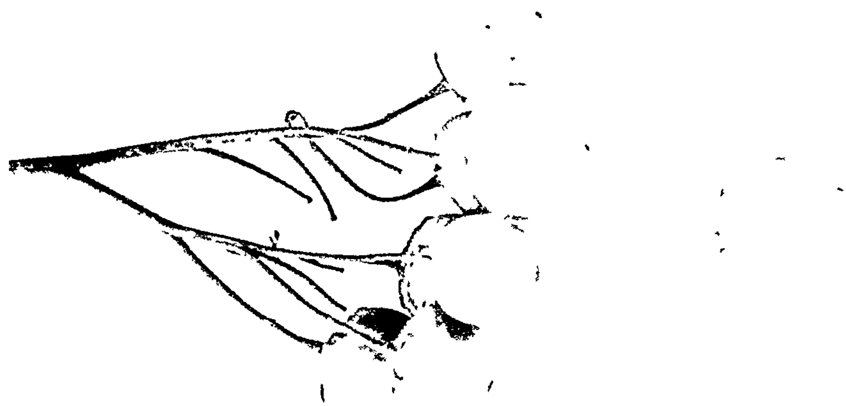


FIG 1 Seedlings of *S neoantipoviczii* growing in a box

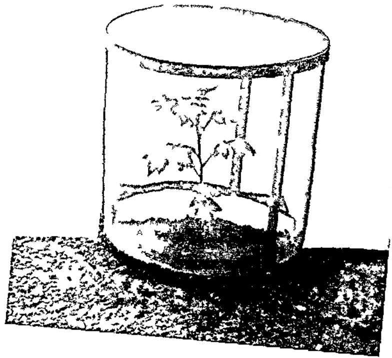


FIG 2 Field cage

flower formation and fruit production studied, with the co-operation of the Directors of Agriculture of the Provinces concerned :—

Chaubattia (Ranikhet) and Khabrar (Ramgarh) in the United Provinces.

Simla, Murree and Kulu Valley in the Punjab.

Shillong in Assam.

Simla was ultimately selected as it combined satisfactory berry formation in most varieties, with other facilities desirable in a potato breeding station.

Raising plants from true seed—The main problems of potato growing in India have been discussed in a general way in a previous section. One of the immediate problems at Simla was to obtain true seeds, and to devise methods of germinating them and raising the plants to maturity.

Preliminary tests of germination in petri dishes were made in 1934 with seeds of India potato varieties and of the following species :—*S. acaule, S. andigenum, S. Antipoviczii, S. Caldassi, S. chacoense, S. Commersonii, S. demissum, S. Fendleri, S. Jamesii, S. Maglia, S. neoantipoviczii, S. otites* and *S. polyadenium*. All except those of *S. acaule* and some of the *andigenum* varieties germinated freely.

Dormancy of seed.—Potato seeds, at least in the case of some varieties, exhibit dormancy. Seeds sown at Pusa one to two months after harvest completely failed to germinate. With increasing length of time after harvest the percentage of seeds which germinated steadily increased. One-year-old seeds gave excellent results.

Chilling the seeds of Admiral, Coonoor White and Pusa White varieties for a week at 9-10°C. before placing in petri dishes for germination gave rather inconclusive results.

As soon as seedlings were large enough to handle* they were pricked out into flats filled with loamy soil (Plate XXVIII, Fig. 1) or directly into the ground. In some cases they were first set out in boxes and later on, after they had made some growth, transplanted in the ground.

An interesting feature was the appearance of weakly yellowish seedlings in fairly large numbers in the case of *S. demissum* and *S. neoantipoviczii*. Counts of normal and yellow seedlings in a number of boxes gave the following results :—

	No. of green seedlings	No. of yellow seedlings.	Total number of seedlings
S. demissum	193	61	254
S. neoantipoviczii	51	15	66

*Generally soon after the appearance of the first pair of foliage leaves.

The figures suggest monofactorial segregation The yellow seedlings died soon after transplanting and were responsible for lowering the survival value of seedlings in *S demissum* and *S neoantipoviczii* to about 50 per cent as compared with over 75 per cent in the case of varieties of *S. tuberosum*

The agricultural value of seedlings cannot be accurately assessed in the first year and it is necessary to protect the plants from infection by insect conveyed virus diseases, which are common in India, particularly in the plains The type of cage adopted at Pusa consisting of a fine wire mesh chamber with a glass roof and double doors is illustrated in Plate XXIX Over 200 boxes of a size 18" × 12" × 10" can be accommodated in this Small cages for use in the field are also illustrated (Plate XXVIII, Fig 2)

Some species and varieties require short day conditions to produce tubers and, if planted in summer, may require special arrangements for curtailing daylight A cover of heavy dark cloth slipped over the type of field cage referred to in the previous paragraph was found to serve the purpose By using this in the mornings and evenings it was possible to give short-day conditions to the potato plants requiring it

SUMMARY

The present position of potato breeding is briefly reviewed and reference is made to recent potato breeding work in Europe and America

The problems of potato breeding in India are discussed Among the most important are the raising of varieties resistant to the Early and Late Blights and to the various virus diseases The problems of dormancy, frost, photoperiodism, etc , are also mentioned

In conclusion, an account is given of the potato breeding experiments recently initiated in Northern India

The writer is indebted to Dr R N Salaman, F R S , for helpful criticism of the manuscript

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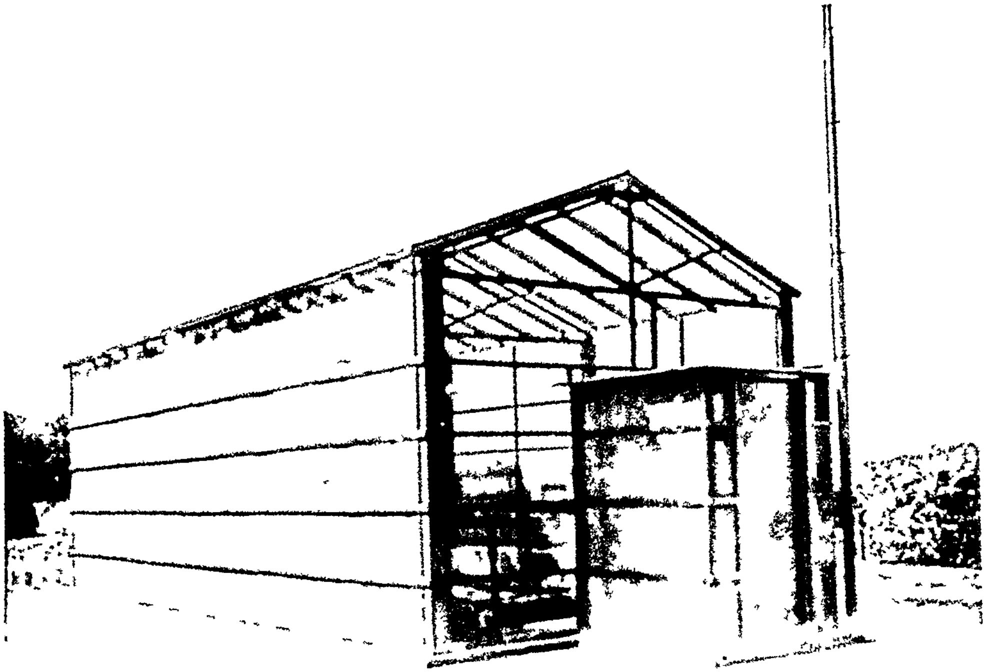

Fig. 1. Large cage : view of exterior

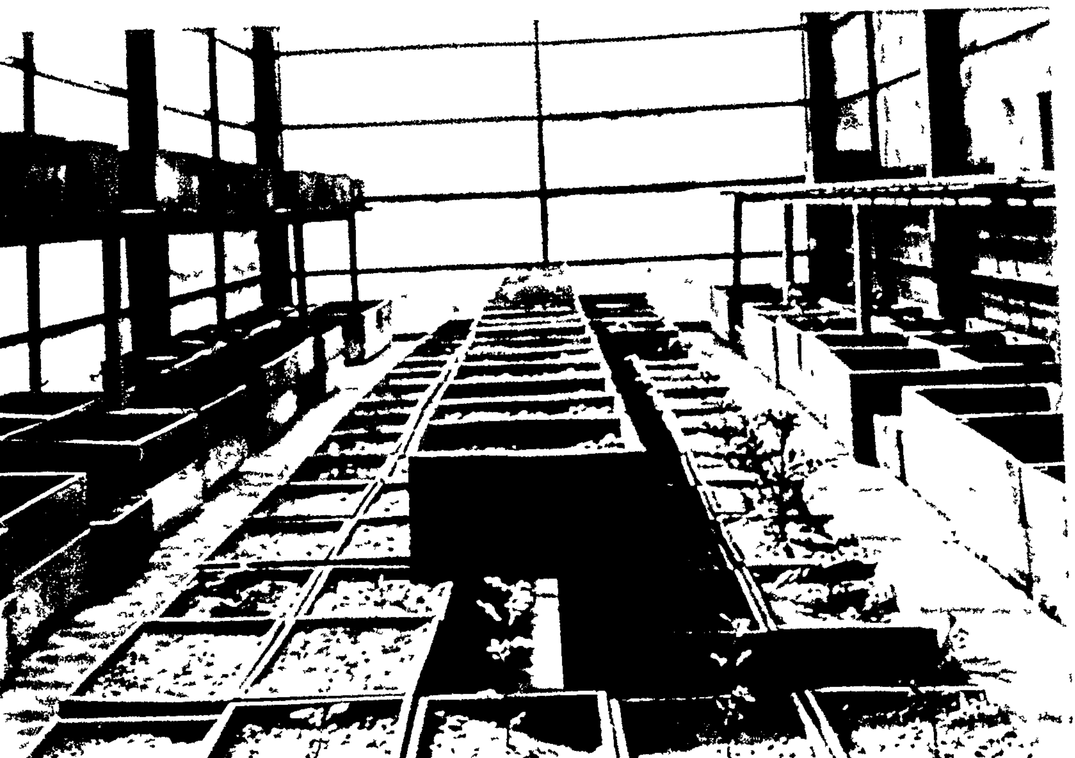

Fig. 1. A typical infestation of *kans*

Fig. 2. The green cover in place

BIOLOGICAL ERADICATION OF *KANS* (*SACCHARUM SPONTANEUM*) IN FIELD PATCHES

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Perennial weeds such as *kans* (*Saccharum spontaneum*) in Central India often infest the cultivators' fields and are responsible for robbing the soil of its productivity, always to the detriment and sometimes to the extinction of crops (Plate XXX, Fig. 1.). The use of a special plough for the eradication of *kans* was reported by Batchelor [1906]. A method for the eradication of such weeds was also evolved at the Institute, involving the use of the '*kans* plough', an American ridging plough modified to suit the purpose [Howard and Howard, 1929]. Perennial weeds can also be more or less effectively eradicated by mechanical cultivation but it is difficult for the Indian ryot to use this method unless special facilities are created for him by others. Further, mechanical cultivation is usually done in dry weather and it is doubtful whether the viability of rhizomes can be completely destroyed by mere desiccation and heat; especially when some of the rhizomes are bound to be covered by the non-conducting earth and protected from such influences as prevail only above the surface. In practice it has been found that it is usually beyond the means of the Indian cultivator to use the *kans* plough. The success of the method depends upon timely interception of fresh growths from the *kans* rhizomes during the rainy season, before they are able to develop sufficiently to feed on the soil nutrients or to establish fresh rhizome development. This process has to be repeated until the food reserves in the rhizomes become depleted and they become incapable of putting forth new shoots. This demands systematic working otherwise it may even help the weed to spread to new areas. Hence when weeds infest large areas as in parts of the Central Provinces or Bundelkhand and become a general scourge leaving no scope for agricultural improvement by individual initiative, organized effort for their control by mechanical means is perhaps likely to be convenient and profitable, until such infestations are reduced to scattered growths. These are then likely to be neglected and allowed to persist just the

same way as *kans* patches are usually left untouched even in normal fields The provision of a simple method within the reach of the individual cultivator seems to be the only way to get rid of patchy weed growths Chemicals such as sodium chlorate, sodium arsenite and sulphuric acid have recently been employed for weed eradication, but trials with these chemicals on *kans* at the Institute have not given satisfactory results and their application was laborious and costly An industrious cultivator usually digs the weed out of the patches but this is done only when it is absolutely necessary, as for instance, in garden lands

It was, however, observed that wherever rainwatered compost was made or weeds were heaped on field margins overgrown with grass, a complete eradication of all growths occurred [Jackson *et al*, 1934] This could obviously be attributed to the adverse effect on the roots of grasses of the products of partially decomposed vegetable material permeating the upper soil zone, of the accumulation of carbon dioxide and of the complete absence of light Artificial mulches using such material as grass, straw, banana leaves and paper have elsewhere been found to suppress weeds and to exercise beneficial influences on the soil and crop It therefore seemed possible to develop a simple method of weed eradication by the application of this principle

As a preliminary study, the Institute fields, Nos 27 and 28, usually water logged and overgrown with a thick mantle of weeds during rains, were sown with *sann* (*crotalaria juncea*) in June 1934 About six weeks after sowing, the growths of *sann* and weeds were cut and laid flat as a cover on the soil with the aid of *bakhar* (local blade harrow) The cover was left untouched up to the end of the rains when for the most part it had decayed There was practically no weed growth left standing and the soil regained tilth earlier than that of other similar fields not so treated This was encouraging

At the beginning of the rains in 1935, six patches of dense *kans* growths were selected in the Institute fields, Nos 3, 30 and 31—the first two being cultivated fields and the third one a grass area Half of the patches in 30 and 31 were covered with wheat *bhusa* (chaffed straw) to about one foot thickness, and the other half with green grasses and weeds, including *kans*, to about the same thickness but applied in successive layers of four inches each layer being compacted by trampling In field No 3 the *kans* patches were covered in the same way by green *sann* (Plate XXX, Fig 2) All *kans* growth was cut down before making the covers These were twice remade with fresh additions wherever necessary due to rotting and shrinkage Any *kans* shoots appearing at the time of remaking the covers were cut back The first cover was made on July 20th and was renewed twice, first after twenty days and then twenty five days later At the time of the first renewal what was originally a dense *kans* growth was already reduced to a few shoots After the second renewal a further reduction occurred, leaving only a few miniature shoots struggling through the cover with scant success The ground below the covers was in a sodden condition

When the covers were finally removed at the end of the rains, in the beginning of October, the *kans* appeared to have become extinct everywhere. The patches covered with wheat *bhusa*, however, showed an appreciable number of yellowish shoots three to four inches in height and the rhizomes were not decomposed. In contrast with this, whatever *kans* shoots existed under the green cover were in a rotting condition and so were all the rhizomes. Stray shoots and rhizomes near the borders of the covers showed some life and were trying to emerge from the cover by bending sideways. This indicated that green material is more effective than dry residues and that covers should extend to a sufficient distance beyond the borders of *kans* patches to prevent the survival of the marginal shoots.

The *kans* patches so treated in fields No. 30 and 3 were, along with the remaining portions, given the usual post-rain preparatory tillage and sown with wheat in October 1935. By December there was apparently no difference between its growth on the *kans* patch and the rest of the field and there was no fresh growth of *kans*. In the grass area, however, a few shoots began to appear, though insignificant compared with the original growth. On the treated patches in cultivated fields, however, *kans* growth failed to reappear up to December 1937. Hence there seems to be a considerable likelihood that perennial weeds can be exterminated in one season by a suitable application of this principle, both in the cultivated fields and grazing lands. At the most the treatment may have to be repeated a second season.

It is evident that a technique on these lines with suitable local modifications will be very useful and well within the cultivator's means, at any rate for all rain-fed tracts, and perhaps even in arid areas under irrigation, in seasons when the rainfall is fairly high. In arable land *kans* growth begins in small isolated patches which are difficult to deal with by bullock-drawn implements and hand-digging is still more laborious and costly. These small patches are obviously very suitable for treatment by the method described.

It is not necessary to grow green material specially for this purpose. It will suffice if the material collected during the usual weeding operations is simply dumped on *kans* patches. No extra cost or labour will thus be required as would occur if green material is specially grown, cut, used as cover and is removed twice as in the test described. Systematic covering of the patches while dumping the weeds and a little trampling will, of course, be necessary for complete eradication in one season. Even when the cultivator cannot afford to take this extra care, most of the weeds in the patches in his field will probably be killed if he only dumps his weedings on top of them.

This application of a common natural process seems so far to have escaped attention but it is apparent that it will be a valuable addition to the cultivator's armaments in his struggle with other forces of nature.

The method has the further advantage that in the very act of weed eradication humus is applied to the soil to compensate for the exhaustion, if any, it had suffered by the weed growth

EFFECT ON THE SUBSEQUENT CROP

An apparent gain in fertility was shown by the behaviour of the following wheat crop After December the crop in the *kans* freed patches was darker, green and taller than the surrounding growth and it ripened earlier by about 15 days

Twelve pairs of plots (10 × 7½') were harvested in the last week of March 1936, each pair consisting of one plot in a *kans* freed patch treated with green material and the other in an adjacent portion of the field where there was neither *kans* growth nor treatment given

A ten feet strip between the adjacent sides of the plots to be compared was excluded as non experimental One of the adjacent flanks of the patches was chosen at random for locating the control plot separately for each pair The yields of both grain and *bhusa* were significantly raised by the treatment

TABLE I (*a*)

Increased fertility due to biological weed eradication Yields of wheat (local durum type) in lbs per acre

	Green cover	No cover	Significant difference on five per cent level
Grain	811	427	134
Straw	908	672	186
Straw/grain*	1 20	1 64	

*The figures are average of ratios obtained for individual plots

Analyses of variance

Wheat—grain Unit—ounce

Due to	D F	Sum of squares	Mean square (M S)	½ log$_e$ (M S)	Z
Blocks	11	266 46	24 22	1 5936	0 1838
Treatments	1	672 04	672 0	3 2552	1 8454**
Error	11	184 46	16 77	1 4098	
Total	23	1122 96			

**Shows the significance on one per cent level (on this and other pages too).

Wheat—straw

Due to	D. F.	Sum of squares	Mean square (M. S.)	$\frac{1}{2}$ $\log_e$ (M. S.)	Z
Blocks . . .	11	300·50	27·32	..	Negative
Treatments . .	1	253·50	253·5	2·7677	1·0284*
Error . . .	11	356·50	32·41	1·7393	
Total .	23	910·50			

Ratio—straw/grain

Due to	D. F.	Sum of squares	Mean square (M. S.)	$\frac{1}{2}$ $\log_e$ (M. S.)	Z
Blocks . . .	11	1·9923	0·1811	..	Negative
Treatments . .	1	1·1704	1·170	$0 - \bar{1}\cdot0785$	0·6828
Error . . .	11	3·2851	0·2986	1·3957	
Total .	23	6·4478			

*Shows the significance on five per cent level (on this and other pages too).

Cotton was grown only in field No. 3 following wheat. Its growth on the treated patches was conspicuous from the beginning. On the 6th of October 1936 observations on cotton were taken on the same plots on which they were taken for wheat in the previous year.

The number of plants, average height of six random plants and the total number of developing bolls per plot were recorded. These with their statistical evaluation are included in Table I (*b*).

TABLE I (*b*)

Effect on the cotton crop grown in 1936

Observations : 105 days after sowing

(*a*) For six random plants	Green cover	No cover	Significant difference on five per cent level
Average height of plants in inches .	39·5	30·7	4·1
(*b*) For ten plots of a total area 750 sq. ft.			
Stand	571	430	..
No. of developing bolls . . .	3,603	1,771	1,000

Analysis of variance—Average height of plants, (Unit-inch)

Due to	D F	Sum of squares	Mean square (M S)	$\frac{1}{2}\log_e\left[\frac{M\ S}{10}\right]$	Z
Blocks	9	325 80	36 20	0 6433	0 3920
Treatments	1	387 20	387 2	1 8282	1 5769**
Error	9	148 80	16 53	0 2513	
Total	19	861 80			

Stand

Due to	D F	Sum of squares	Mean Square (M S)	$\frac{1}{2}\log\left[\frac{M\ S}{100}\right]$	Z
Blocks	9	7605 45	845 1	1 0672	0 5300
Treatments	1	994 05	994 1	1 1484	0 6112
Error	9	2635 45	292 8	0 5372	
Total	19	11234 95			

Number of developing bolls

Due to	D F	Sum of squares	Mean square (M S)	$\frac{1}{2}\log_e\left[\frac{M\ S}{1000}\right]$	Z
Blocks	9	110953	12328	1 2560	0 1160
Treatments	1	167811	167811	2 5614	1 4214**
Error	9	87986	9776	1 1400	
Total	19	366750			

The stand on the treated patches though numerically greater did not significantly differ from that on the untreated ones The treated patches, however, grew a taller crop and produced a greater number of bolls per plant The final yields, total as well as for two pickings of seed cotton from the treated patches were also higher than those of the controls as will be seen from table I (c)

TABLE I (c)

Influence of biological weed-eradication

Yields of seed cotton-lbs. per acre

Yield from	Green cover	No green cover	Significant difference on five per cent level
Three pickings (total)	818·8	339·5	271·0
First picking	326·9	109·0	171·
Second picking	410·2	138·8	174·
Third picking	81·7	91·7	..

Analysis of variance (Unit—½ oz.)

(Three pickings total)

Variance due to	D. F.	Sum of squares	Mean square (M. S.)	½ log (M. S.)	Z
Blocks . . .	9	9125·2	1013·9	3·4607	0·0768
Treatments . .	1	13939·2	13939·2	4·7713	1·3874**
Error . . .	9	7824·8	869·4	3·3839	..
Total .	19	30889·2			

First picking

Variance due to	D. F.	Sum of squares	Mean square (M. S.)	½ log $\left[\frac{M.S.}{100}\right]$	Z
Blocks . . .	9	2013	223·7	0·4029	..
Treatments . .	1	2880	2880	1·6802	1·2772**
Error . . .	9	2015	223·9	0·4030	..
Total .	19	6908			

Second picking

Variance due to	D F	Sum of squares	Mean square (M S)	½ $\log_e \left[\frac{M\ S}{100}\right]$	Z
Blocks	9	2970 2	330 0		Negative
Treatments	1	4470 0	4470 0	4 2026	1 2590**
Error	9	3243 5	360 4	2 9436	
Total	19	10683 7			

Third picking

Variance due to	D F	Sum of squares	Mean square (M S)	½ $\log_e$ (M S)	Z
Blocks	9	152 5	16 9		Negative
Treatments	1	6 1	6 1		Negative
Error	9	162 4	18 0		
Total	19	321 0			

The increased fertility thus seems to have persisted in the second year This is however, only to be expected from the results ordinarily obtained when soil-humus is increased The eradication of the weed and increased fertility in *kans* patches occurring in the manner described above is simply a practical illustration of the inevitable working of the two universally observed natural phenomena—(1) The impossibility of plant life surviving in anærobic media produced by rotting vegetable matter and (2) the increase in productivity following the application of humus to soils Being so, it is expected that the Indore results are very likely to be obtained elsewhere by the same or a suitably modified technique capable of producing similar soil conditions

In addition to increased yields, the wheat grain produced from the treated patches appeared distinctly superior to that from the untreated ones It resembled the well known *ekdania* variety in Central India—bold, horny and translucent—in appearance, though ordinary local Durum type was sown That from the untreated plots was smaller with yellowish, opaque blotches and generally a chalky fracture

On analysis of the average samples the following results were obtained (Tables II and II (*a*)

TABLE II

Influence of biological weed-eradication, on the development and composition of wheat grown subsequently. Physical observations

Wheat grain	Weight of 500 seeds (in grms.)	Volume of 500 seeds (in c. c.)	Per cent undeveloped seed	Moisture
(1) from control plots . .	26·0	32·3	20·0	4·36
(2) from the treated plots .	27·2	32·8	14·0	4·95
(3) of *ekdania* variety from Runglia, Dhar State .	29·1	34·5	14·0	4·54

TABLE II (*a*)

Chemical composition (percentage on oven-dry basis)

Total N	Albuminoid N	Ash	Crude fibre	Ether extract	Gluten	Starch	Crude proteins	Albuminoids
1·65	0·82	1·51	1·60	2·12	8·04	49·23	10·31	5·13
2·07	1·13	1·33	1·66	2·15	11·53	31·79	12·94	7·06
2·08	1·79	1·35	1·13	1·54	7·51	45·52	13·00	11·19

The superior quality of the grain produced in the *kans*-freed patches is clearly shown.

One-inch core samples of soil were taken up to a depth of fifteen inches at one random point in each plot. Eye-inspection of the cores showed two distinct horizons, zero to six inches and six to 15 inches. Each core was accordingly separated into two such portions. Soil of the same zones from plots, in the same portion of the fields was pooled together to make one composite sample for that portion of the fields. These were examined for their contents of organic matter by Robinson, McLean and Williams method. The results are given in Table III.

TABLE III

Increase in organic matter content of soils due to biological weed eradication

Organic matter = Carbon content × 1 724

Description	Horizon 0" 6"	Horizon 6" 15"
(Soil from field No 3)—		
untreated	0 60	0 63
sann treated	0 71	0 56
untreated	0 69	0 81
sann treated	0 86	0 80
(Soil from field No 30)—		
Untreated	0 68	0 68
Treated (green weeds)	0 89	0 77
, Untreated	0 69	0 71
, Treated (*bl usa*)	0 90	0 69

The treated patches apparently showed a higher content of organic matter in the upper zones of their soils than that of the corresponding control and the better quality of grain obtained may be due to consequent changes in soil characteristics In order to verify this further examination is being made of these soils and of those from *kans* patches where the weed has not been biologically eradicated and where crops cannot be successfully grown It is hoped thus to separately assess the effect of *kans* growth itself on the soil as well as estimate the influence of the treatment. These results will be presented in a further communication The differences in wheat quality due to changes in environment including soil condition have been recorded by many workers (Wheat Studies 1934)

It has been found practicable to eradicate perennial weeds by applying to the land a monsoon cover of green material allowed to decay *in situ* The weed infested soil appeared to have become more productive than the surrounding area being enriched with organic matter and the quality of wheat grain grown upon it was also superior

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A STUDY OF SURTI BUFFALOES REARED AT THE POONA AGRICULTURAL COLLEGE DAIRY

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IN India, the buffalo supplies the bulk of the milk and milk products such as butter (both for table use and cooking purposes), ghee, *khoa* (dessicated milk), curd, buttermilk, etc., and accordingly is the main dairy animal of the country. One of the most important problems for a dairyman, either in business for the production and disposal of milk or as a breeder with a view to establish an economic type of dairy animal for the country, is to maintain a steady and regular supply of milk economically.

In order to achieve this object the following are the initial problems which require to be investigated :—

(1) Distribution of calvings in different months.

(2) Lactation period and dry period in different calvings.

(3) Distribution of milk yield in different lactations month by month.

(4) Persistency in lactation yield month by month.

With a view to study these problems, the records of farm-bred buffaloes of the Surti breed have been examined in detail by the writer at the Agricultural College Dairy, Poona, where this breed is systematically reared and maintained. Animals that had aborted or given birth to a premature calf and those that were purchased from outside have not been taken into consideration. Under usual conditions, the animals are fed with green fodder at milk-stage (throughout the year) *viz.*, maize, *nilwa*, oats and peas, lucerne and guinea grass, supplemented with small quantities of chaffed *kadabi*. Neither grass, hay nor any grazing is given to the herd. The concentrates fed mainly consist of a mixture of wheat-bran, groundnut cake, crushed *kulthi* (*Dolichos biflorus*) and cotton seed, with two ozs. of common salt per head per day, at the rate of 4·5 to 5 lbs. of above mixture for every 10 lbs. of milk produced.

The procedure adopted in the study was to record separately the monthly milk yield of buffaloes in different lactations, together with the dates of calving and dates of going dry in order to work out the following data —

(1) Actual number of days a buffalo was in milk during the first month of her lactation (as it is generally a broken month)

(2) Actual milk yield in each month

(3) Number of days in milk and dry in each calving period

I DISTRIBUTION OF CALVING OF SURTI BUFFALOES IN DIFFERENT MONTHS

The total number of cases examined in the above study was 335

TABLE I

Showing distribution of calvings of Surti buffaloes in different months in the year

Month	Number of calvings	Percentage of calvings
January	16	4 77
February	6	1 79
March	8	2 39
April	4	1 20
May	9	2 69
June	8	2 39
July	19	5 67
August	55	16 41
September	69	20 60
October	65	19 40
November	44	13 14
December	32	9 55
Total	335	100 00

The above table shows that (1) there is a particular period, *viz*, August to November, when about 70 per cent of buffaloes calve as a result of which there

is a large production of milk up to January and thereafter the milk supply goes down gradually till the next calving season commences, (2) the maximum number of calvings is in September *i.e.*, about 21 per cent—and the minimum *i.e.*, 1·2 per cent, in April.

The data, when further examined with respect to first calvings only, give very interesting information, showing the natural tendency towards calvings—even in the case of first calvers—as shown below :—

TABLE II

Showing the distribution of first calving among Surti buffaloes in different months in the year

Month of calving	Number of calvings	Percentage distribution	
January	4	4·76	
February	3	3·57	
March	3	3·57	
April	..	..	
May	..	..	
June	..	..	
July	..	..	
August	13	15·48	83·34
September	29	34·52	
October	18	21·43	
November	10	11·91	
December	4	4·76	
Total	84	100·00	

It appears from the above table that (1) the first calvings are mainly concentrated from August to November to the extent of about 83 per cent and the remaining 17 per cent is distributed from December to March, (2) there were no first calvings from April to July and (3) the maximum number of first calvings *i.e.*, 34·5 per cent, falls in the month of September.

Fig. 1 shows the percentage distribution of calvings in different months of the year.

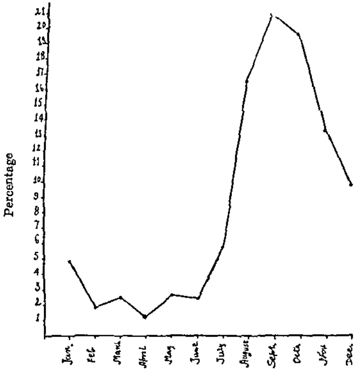

Fig 1. Showing percentage distribution of calvings in Surti breed of buffaloes

II. Lactation period and dry period among Surti buffaloes in different calvings

(a) *Lactation period* —There were 335 buffaloes for the study of the distribution of calvings as given under Table I, but in some of these all data regarding the lactation length, dry period and lactation yield were not complete; thus

rejecting the animals whose data were incomplete, there remained 218 buffaloes under the study of lactation period and dry period as given below :—

TABLE III

Showing the mean standard deviations and coefficient of variation of lactation-length among Surti buffaloes in different lactations

Number of lactation	Number of cases	Mean lactation length in days	Standard deviation	Coefficient of variation
1st	72	383·7	134·1	34·9
2nd	47	357·7	90·9	25·4
3rd	33	338·6	67·8	20·0
4th	24	317·4	68·7	21·6
5th	15	321·0	87·6	27·2
6th	11	301·2	59·1	19·6
7th to 10th	16	311·2	45·9	14·7
Total .	218	..	..	..
Average .		350·1	80·1	22·8

Table III indicates that (1) the average lactation length is 350 days in Surti buffaloes, (2) the first lactation is the longest of all, *viz.*, 383 days, (3) the lactation length gradually decreases from first lactation onwards, and (4) on an average no mature animal remains in milk for more than thirteen months.

(b) *Dry period.*—There were 218 buffaloes (*i e*, the same animals as studied under lactation period) for the study of dry period as given below :—

TABLE IV

Showing the mean standard deviations and coefficient of variation of dry period among Surti buffaloes in different lactations

Number of lactation	Number of cases	Mean dry period in days	Standard deviation	Coefficient of variation
1st	72	118·9	75·6	63·6
2nd	47	118·7	50·3	42·4
3rd	33	108·8	57·0	52·4
4th .	24	101 2	49·8	49·2
5th	15	105 0	28·8	27·4
6th	11	99 6	36·9	37·0
7th to 10th	16	86 2	51·6	59·8
Total	218	.	..	..
Average		111·0	60·3	54·3

It appears from Table IV that (1) the average length of dry period is 111 days in Surti buffaloes, (2) on an average no mature animal remains dry for more than four months and (3) the dry period gradually decreases as the animal advances in lactation

The following table gives a consolidated review of the lactation period and dry period of Surti buffaloes in different lactations.

TABLE V

Showing the length of lactation and dry period among Surti buffaloes in different lactations

Number of lactation	Number of cases	Mean lactation length in days	Mean dry period in days	Interval between two calvings in days
1st	72	383·7	118·9	502·6
2nd	47	357·7	118·7	476·4
3rd	33	338·6	108·6	447·2
4th	24	317·4	101·2	418·6
5th	15	321·0	105·0	426·0
6th	11	301·2	99·6	400·8
7th to 10th	16	311·2	86·2	397·4
Total	218	..	..	..
Average	..	350·1	111·0	461·1

Table V shows that the interval between two calvings works out to 461 days in Surti buffaloes—350 days in milk and 111 days dry—or in other words a Surti buffalo, on an average, conceives 148 days after calving (461 days interval between two calvings *minus* 313 days as gestation period).

Fig. 2 shows the graphical review of lactation length and dry period of Surti buffaloes during different calvings.

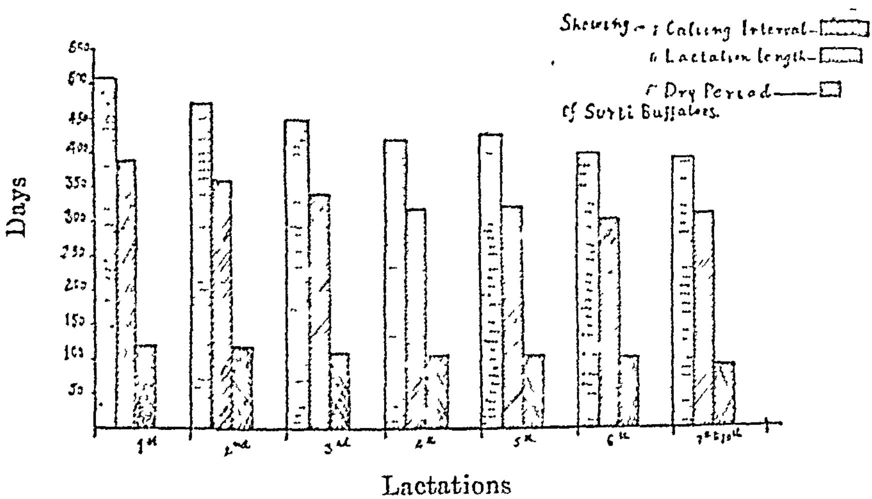

FIG. 2. Showing calving interval, lactation length and dry period of Surti buffaloes

III. DISTRIBUTION OF MILK YIELD IN DIFFERENT LACTATIONS MONTH BY MONTH

There were 218 cases under study from one to ten lactations. Table VI gives the average monthly milk yield of Surti buffaloes till the completion of drying of all cases in each lactation.

TABLE VI

Showing the average monthly milk yield of Surti buffaloes in different lactations

Month	1st lactation		2nd lactation		3rd lactation		4th lactation		5th lactation		6th lactation		7th to 10th lactation in one group	
	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases
	in(18 2)		in(15 8)		in(17 9)		in (14)		in (17 2)		in (12 9)		in(16 8)	
1st	190 days	72	217 days	47	305 days	33	234 days	24	288 days	15	216 days	11	267 days	16
2nd	4[illegible]2	72	564	47	615	33	614	24	651	15	646	11	589	16
3rd	433	72	552	47	600	33	639	24	629	15	656	11	593	16
4th	409	72	512	47	564	33	5[illegible]6	24	580	15	620	11	555	16
5th	393	72	470	47	524	33	540	24	538	15	537	11	509	16
6th	3[illegible]2	72	448	47	474	33	488	24	512	15	524	11	473	16
7th	350	72	406	47	435	33	434	24	464	15	451	11	44[illegible]	16
8th	322	71	345	47	379	33	376	24	411	15	407	11	401	16
9th	274	70	317	44	331	32	303	24	353	14	396	10	34[illegible]	16
10th	246	62	280	40	287	31	274	19	247	13	275	10	212	16
11th	217	60	223	37	191	27	225	15	200	9	266	7	189	8
12th	218	38	195	31	158	17	165	10	217	5	171	5	141	5
13th	208	31	209	22	123	11	128	5	103	4	177	2	180	2
14th	1[illegible]3	28	190	19	220	4	188	3	263	1	277	1	96	2
15th	178	23	137	15	167	4	154	3	211	1	206	1	8	2
16th	173	21	165	8	124	4	59	3	199	1	83	1		
17th	149	21	118	6	75	2	21	1	170	1				
18th	137	17	1[illegible]4	3	39	1			150	1				
19th	101	15	93	2					164	1				
20th	120	10	10	1					132	1				
21st	104	7							5	1				
22nd	66	5												
23rd	100	2												
24th	18	1												
Total	5378		56[illegible]4		5591		5418		6496		5909		5011	

Table VI shows that (1) irrespective of the number of lactations, there is a general tendency towards decline in milk yield as the lactation period advances, in spite of the fact that the number of animals in milk remains almost constant during first eight to nine months of the lactation and (2) the fifth lactation shows the highest yield.

Table V indicates what the mean lactation period of a Surti buffalo is likely to be during different lactations. Table VII is based on these periods in order to show the average milk-yielding capacity of a Surti buffalo in different lactations.

TABLE VII

Showing the mean lactation yield, lactation length, dry period and annual average yield of Surti buffaloes in different lactations

Number of lactation	Lactation yield in lbs.	Number of cases	Mean lactation length in days	Mean dry period in days	Total interval between two calvings in days	Annual average yield in lbs. (based on calving interval)
1st . . .	4054	72	383·7	118·9	502·6	2944
2nd . . .	4589	47	357·7	118·7	476·4	3516
3rd . . .	4772	33	338·6	108·6	447·2	3895
4th . . .	4703	24	317·4	101·2	418·6	4101
5th . . .	4882	15	321·0	105·0	426·0	4183
6th . . .	4857	11	301·2	99·6	400·8	4423
7th to 10th .	4521	16	311·2	86·2	397·4	4152
Total .	..	218	..	..	..	..
Mean .	4609	..	350·1	111·0	461·1	3887

Table VII shows that (1) the yield is gradually increasing from first lactation onwards reaching the maximum, *viz.*, 4882 lbs. in the 5th lactation, (2) the mean lactation yield works out at 4609 lbs. with 461 days as interval between two calvings (350 days in milk and 111 days dry) and (3) the average annual yield (based on milking and dry period combined) works out at 3887 lbs.

Fig 3 gives a graphical representation of the lacation yield.

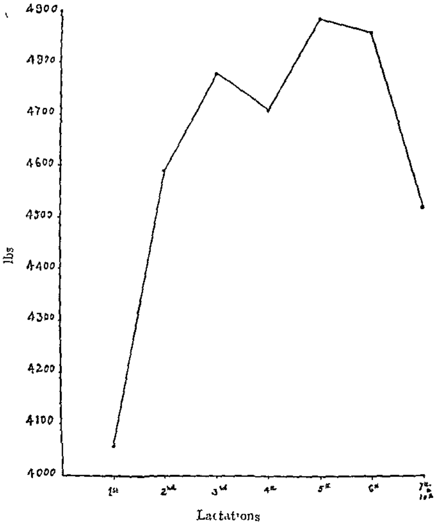

Fig. 3 Showing lactation yield of Surti buffaloes

IV Persistency in lactation yield month by month

In the study of persistency of milk-yield the first month of calving, which is usually a broken month, has been omitted; moreover the yield in the first month

is also irregular. The persistency is therefore worked out from 2nd to 3rd month, 3rd to 4th month and so on till the 11th month of lactation, as after that period most of the animals dry off and the population becomes very small.

Table VIII shows month to month decline in milk yield (in percentage) in different lactations.

TABLE VIII

Showing month-to-month decline in milk-yield in different lactactions of Surti buffaloes (in percentage)

Month	1st lactation	2nd lactation	3rd lactation	4th lactation	5th lactation	6th lactation	7th to 10th lactation	Average decline per 100 lbs.*
2nd to 3rd . .	+2·6	2·1	2·4	+4·1	3·4	+1·6	+0·7	+0·15
3rd to 4th . .	5·5	7·2	6·0	9·9	7·8	5·5	6·4	6·81
4th to 5th . .	3·9	6·4	7·0	6·2	7·2	13·4	8·3	6·52
5th to 6th . .	5·3	6·4	9·5	9·6	4·8	2·4	7·1	6·78
6th to 7th . .	5·9	9·3	8·2	11·1	9·4	13·9	5·5	8·38
7th to 8th . .	8·0	15·0	12·9	13·4	11·4	9·8	10·3	11·39
8th to 9th . .	14·9	8·0	12·7	19·4	14·1	2·7	13·9	12·84
9th to 10th . .	10·2	11·6	19·3	9·6	30·0	30·6	38·5	17·32
10th to 11th .	11·7	20·3	28·4	17·9	15·4	3·3	10·8	16·70
Average decline .	7·63	10·05	12·07	11·74	12·21	10·48	12·47	10·23

It appears from Table VIII that (1) the decline per 100 lbs. is almost constant for first six months, after which the effect of pregnancy is felt on the milk yield, which is indicated by a sharp drop, (2) the first lactation shows the minimum decline, *viz.*, 7·63 per cent, (3) the decline in the remaining lactations remains almost uniform *i.e.*, 10·05 to 12·47 per cent and (4) the average monthly decline of all lactations combined works out at 10·23 per cent.

**Vide* reference Kartha [1934]

Figs. 4 and 5 show the rates of decline in milk yield

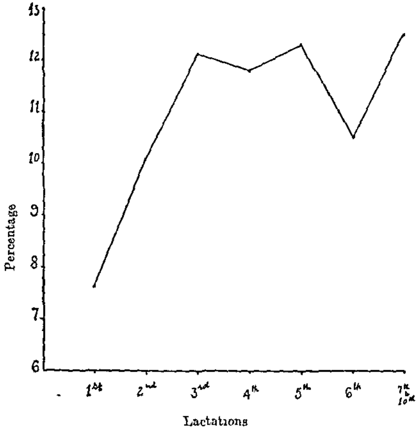

FIG 4 Showing the rate of decline in milk yield of Surti buffaloes in different lactations (in percentage)

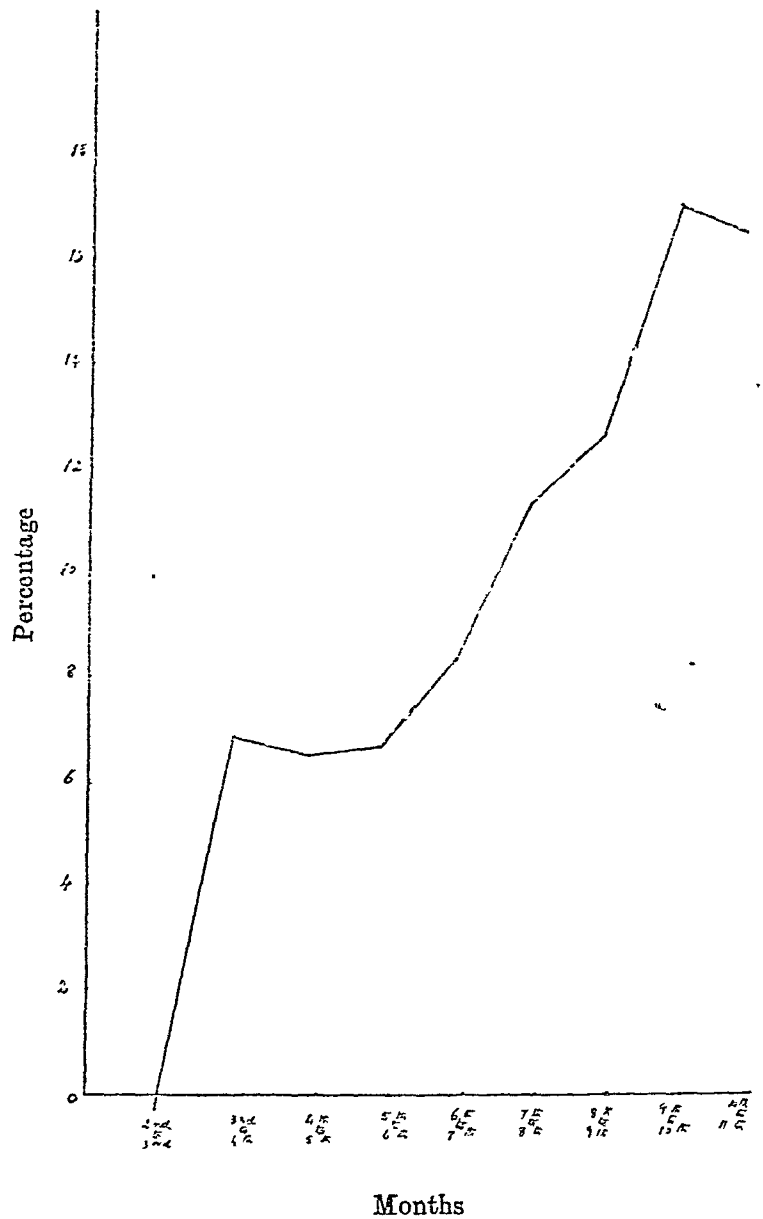

FIG. 5. Showing month-to-month decline in milk yield of Surti buffaloes (of all lactations combined) (in percentage)

SUMMARY

(1) About 70 per cent of Surti buffaloes calve between August and November the least number of calvings taking place in the month of April

(2) Eighty three per cent of first calvings occur between August and November—there being no first calvings from April to July

(3) On an average, a Surti buffalo lactates for 350 days and then remains dry for 111 days thus the interval between two calvings works out at 461 days

(4) The first lactation of a Surti buffalo is the longest, *viz*, 383 days and the sixth is the shortest, *viz* 301 days

(5) The number of animals in milk remains almost constant during the first eight to nine months of a lactation

(6) Average lactation yield of a Surti buffalo works out at about 4 600 lbs with 461 days (350 days in milk and 111 days dry) as mean interval between two calvings

(7) The annual average yield of a Surti buffalo is about 3 900 lbs

(8) The average monthly decline in the milk yield of Surti buffaloes works out at about 10 23 per cent The first lactation shows the minimum decline, *viz*, 7 63 per cent

REFERENCE

Kartha K P R (1934) *Ind J Vet Sci & Anim Husb* 4 36 62

gravity, titrable acidity, *p*H (determined colorimetrically), mineral matter, fats (as ether extractives) crude protein protein nitrogen non protein nitrogen, carbohydrates (by difference), calcium, phosphorus and iron were determined Fermentation was allowed to proceed at room temperature, which ranged at the time of the experiment between 18° and 21°C Representative sample were taken as far as possible diluted to definite proportions, and then analysed Dilution was carried to an extent corresponding with the practice followed in homes in various sections of the population, in poor homes considerable quantities of water are added

Analyses of skimmed or separated milk sometimes known as 'buttermilk' were not carried out since data already exist regarding the composition of such milk

Two samples of 'buttermilk' of type (3) were analysed, one sample representing the washings during the manufacture of butter from cream supplied by a contractor to a neighbouring dairy (sample 1) the other sample (2) being washings obtained from cream made in the dairy itself The cream was diluted with water, kept at room temperature for about twenty four to forty eight hours, and then churned The fat that separates was removed The fluid left over represents 'buttermilk'

In addition, 'buttermilk' was prepared from comparable samples of cow's milk obtained from the same dairy, fermented with pure cultures of *B Acidophilus* Three flasks containing 500 c cs of boiled milk were, on cooling, each inoculated with 10 c cs of *B acidophilus* culture and allowed to ferment under aseptic conditions in an incubator maintained at 37°C The contents of the flasks were analysed after eighteen twenty four and forty two hours of fermentation after partial removal of fat Simultaneously two more flasks containing a similar quantity of milk were allowed to ferment with an equivalent amount of a mixed and impure culture of *B acidophilus*, in a manner simulating the practice followed in Indian homes The contents of the flasks were analysed after eighteen and twenty four hours of fermentation after partial removal of fat These experiments were carried out to find out whether any differences in chemical composition could be detected as a result of fermentation with pure and with mixed culture of *B acidophilus*

The results of the analyses of the different samples, are set out in Tables I and II

TABLE I.

The chemical composition of "buttermilk"

	Moisture per cent	Total solids per cent	Specific gravity	pH	Titrable acidity, c.c. N/10 alkali per 100 c.c.	Crude protein, per cent	Protein nitrogen per cent	Non-protein nitrogen per cent	Ether extractives per cent	Mineral matter, per cent	Carbohydrates, per cent	Calcium (Ca) per cent	Phosphorus (P) per cent	Iron (Fe) Mg. per cent	Calorific value per 100 g.
Milk (Dairy), with inoculum.	89·1	10·9	1·017	5·2	15·3	2·7	0·403	0·022	1·5	0·7	3·0	0·12	0·08	0·19	63
'Buttermilk' (after 18 hrs. fermentation) no dilution.	92·1	7·9	1·012	4·5	91·0	2·5	0·398	0·037	2·1	0·7	2·6	0·12	0·09	0·19	39
'Buttermilk' (18 hrs. fermentation and diluted) . 2:1	94·8	5·2	1·020	4·5	68·5	1·9	0·281	0·029	1·5	0·5	1·3	0·08	0·06	0·13	26
'Buttermilk' (18 hrs. fermentation and diluted) . 1:1	96·2	3·8	1·010	4·4	49·0	1·4	0·202	0·023	0·8	0·4	1·2	0·06	0·04	0·10	18
'Buttermilk' (18 hrs. fermentation and diluted) . 1:2	97·6	2·4	1·004	4·2	36·0	0·9	0·135	0·015	0·6	0·2	0·7	0·04	0·03	0·06	12
'Buttermilk' (18 hrs. fermentation and diluted) . 2:5	97·8	2·2	1·003	3·8	30·0	0·9	0·113	0·013	0·5	0·2	0·6	0·03	0·03	0·05	11
'Buttermilk' (18 hrs. fermentation and diluted) . 1:3	98·2	1·8	1·003	3·8	25·0	0·7	0·097	0·010	0·5	0·2	0·4	0·03	0·02	0·05	9
'Buttermilk' (18 hrs. fermentation and diluted) . 2:7	98·4	1·6	1·002	3·8	23·0	0·6	0·091	0·010	0·5	0·2	0·3	0·03	0·02	0·01	8
'Buttermilk' (18 hrs. fermentation and diluted). . 1:4	98·6	1·4	1·001	3·8	19·5	0·6	0·080	0·007	0·4	0·1	0·3	0·03	0·02	0·04	7
'Buttermilk' (18 hrs. fermentation and diluted) . 1:5	98·8	1·2	1·000	3·8	17·0	0·5	0·068	0·006	0·3	0·1	0·3	0·02	0·01	0·03	6
'Buttermilk' from cream during manufacture of butter—Sample 1.	97·9	2·1	1·003	4·0	21·5	0·6	0·085	0·011	0·5	0·1	0·9	0·03	0·02	0·57	11
'Buttermilk' from cream during manufacture of butter—Sample 2.	97·9	2·1	1·002	4·4	14·0	0·4	0·063	0·009	0·9	0·1	0·7	0·02	0·01	0·17	13

TABLE II

The chemical composition of "buttermilk", obtained with pure and with mixed culture of B acidophilus

	Duration of fermentation	Moisture per cent	Total solids per cent	Specific gravity	pH	Titrable acidity c c N/10 alkali per 100 c c	Crude protein per cent	Protein nitrogen per cent	Non protein nitrogen per cent	Ether extractives per cent	Mineral matter per cent	Carbohydrates per cent	Calorific value per 100 g
Milk (Dairy) with inoculum	hrs 0	89.1	10.9	1.017	5.2	15.3	2.7	0.403	[illegible]	4.5	0.7	3.0	[illegible]
"Buttermilk", made with mixed culture of *B acidophilus*	18	92.1	7.9	1.012	4.5	94.0	2.5	0.398	0.037	2.1	0.7	[illegible]	33
"Buttermilk", made with mixed culture of *B acidophilus*	24	93.0	7.0	1.010	[illegible]	100.0	[illegible]	0.390	0.035	2.5	[illegible]	[illegible]	35
"Buttermilk", made with pure culture of *B acidophilus*	18	91.8	8.2	1.023	5.0	31.0	2.5	[illegible]	0.061	1.4	0.7	3.8	37
"Buttermilk", made with pure culture of *B acidophilus*	[illegible]	91.4	8.6	1.025	5.0	40.0	2.5	0.366	0.111	1.6	0.7	3.4	42
"Buttermilk", made with pure culture of *B acidophilus*	42	92.3	7.7	[illegible]	4.5	[illegible]	2.6	0.237	0.044	1.3	[illegible]	2.8	38

It is to be seen from the above tables that a little nitrogen is lost on prolonged fermentation, how this loss occurs is obscure. During the process of souring milk the non-protein nitrogen increases, which is presumably due to the splitting up of the complex protein molecule into simpler amino-acids. It is thus possible that the nitrogen of soured milk has a higher biological value than that of sweet milk. The increase in non-protein nitrogen is not proportional to the duration of fermentation. Titrable acidity, as is to be expected, increases with fermentation.

As the dilution increases the amount of fat that separates and can be removed, becomes greater. The composition of the 'buttermilk' at various dilutions as regards elements other than fat is therefore not exactly proportional to the degree of dilution.

The composition of the 'buttermilk' prepared with a pure culture of *B. acidophilus* is not very different from that of 'buttermilk' prepared with impure cultures of this organism, except as regards specific gravity. The former kind of 'buttermilk' is consistently lighter (Table II), which probably is due to a difference in texture of the 'curds' in the two samples.

The chemical composition of a sample of 'buttermilk' of type 1 can be roughly deduced from its content of total solids. In practical nutrition work, determination of total solids, or of specific gravity by an ordinary lactometer may be of service. In diet surveys an attempt should be made to record intake of 'buttermilk' in terms of the original whole milk from which it is derived.

'Buttermilk' obtained from cream during churning (type 3) is of low nutritive value, since most of the nitrogen, fat and inorganic elements are removed when the original separation of the cream from milk takes place.

NOMENCLATURE

In India the term 'buttermilk' usually means soured milk, with the fat partially removed, and diluted to varying degrees (type 1). Strictly speaking, the term should be applied only to the liquid obtained during the manufacture of butter from cream (type 3). Considerable confusion has been caused by the use of the word to describe products of quite different nutritive value. Vernacular terms may be equally misleading, as is indicated by the following extract from a letter from Colonel Sir Arthur Olver, Animal Husbandry Expert to the Government of India, to the Director of Nutrition Research, Coonoor.

"In the Punjab the word *lassi* is used for three products.

(1) The fluid which remains when butter is made from soured whole milk by churning. Some water is usually added.

(2) The curd prepared from soured whole milk. This contains the whole of the butterfat in the original milk but is diluted with water and thoroughly stirred before taking. This is known as '*adh rirka*' or '*lassi*'.

(3) Ordinary sweet milk diluted with water before drinking is known as '*kachi lassi*'

These are the names in common use in the Punjab, and presumably the words '*chach*' and '*chhas*', used in other parts of India, may have a similar wide meaning. I find that 'buttermilk' is defined in the dictionary as "the liquid remaining when butter has been churned from cream". Whether that cream has been obtained by mechanical separation or by steaming the milk over a water bath does not much matter. This fluid contains only a fraction of the protein and salts in the original milk and that is the meaning which I have always attached to the term 'buttermilk'. Thus to me this term does not at all indicate the product with which you are mainly concerned and which is of such great dietary importance, *viz* the fluid which remains after the butterfat has been removed from milk for the production of cream, ghee or butter. That residue contains practically the whole of the protein and salts of the full milk and would, I think, be best indicated in India by using the rather cumbersome caption, 'skimmed or separated milk (*lassi chach or chhas*)'.

The term 'buttermilk' is definitely misleading and I suggest that the above is the only way of indicating the product in which as nutritionists we are mainly interested."

In educational work it is difficult to avoid employing the term 'buttermilk' to indicate soured skimmed milk, diluted or otherwise, since the use of the term is popular and widespread. At present the only way out of the difficulty is to add a description of the method of preparation when dealing with the various milk products consumed in India.

Summary

1 The chemical composition of various types of 'buttermilk' has been investigated.

2 A slight loss of nitrogen was found to occur when fermentation was prolonged. Non protein nitrogen increased with souring.

3 In practice the composition of a sample of 'buttermilk' can be roughly estimated from its content of total solids or specific gravity by an ordinary lactometer.

4 Confusion is caused by the use of the term 'buttermilk' to denote various preparations. Strictly speaking, 'buttermilk' means the liquid remaining when butter has been churned from cream. The use of the term to describe other milk preparations can be justified only by widespread popular usage. To avoid confusion, the method of preparation should be described when the term 'buttermilk' is employed.

Acknowledgment

This work was carried out under the Indian Research Fund Association.

NOTES

COTTON CULTIVATION IN IRAN

[From an article " Die Landwirtschaftliche Produktion Irans " by Bruno Laupert, in " Der Tropenpflanzer ", Volume 41, No. 2, February 1938 (page 60), (translated by Dr. W. Burns, Agricultural Expert, Imperial Council of Agricultural Research).].

PRODUCTION statistics prepared by the Agricultural Department for the Iranian years 1310 to 1313 are available. The occurrence of errors in the first year of such statistics both in yields and in areas is understandable. The hectare is not yet standardised in all parts of the country. The old unit of surface measurement was the kharwar, but the kharwar was and is a measure of weight also. As a measure of surface it denotes the area on which a kharwar of wheat or barley is used for sowing. 1 kharwar = 100 batman, 1 batman = about 3 kg. (exactly 2970 grms.). Therefore a kharwar is about 300 kg. (exactly 297 kg.). Since 1934 the metric system has been generally introduced into Iran; also the weights gramme, kilogramme, tonne (metric ton)—thousand kilogrammes. Recent statistics from the Iranian year 1313 (*i.e.*, A. D. 1934) are recorded in the new metric system, *i.e.*, in metric tons, kilogrammes and hectares. These last figures of the year 1313 can therefore be taken as fairly reliable. The production of the most important products was as follows :—

Tons (Metric)

	1310 (1931)	1311 (1932)	1312 (1933)	1313 (1934)
Cotton	25,916	53,257	52,884	92,588

A comparison of the present production figures with those of export in the same years show the following :—

	1310-11 (1931-32)	1311-12 (1932-33)	1312-13 (1933-34)	1313-14 (1934-35)	1314-15 (1935-36)
Cotton . . .	29,600	14,300	26,360	27,823	16,745

Cotton production figures give the seed cotton, export figures only the lint : the relationship of lint to seed cotton weight is about 1 : 2. There seem to be several errors in these statistics.

Cotton —The area cultivated has increased markedly from 53 000 hectare in 1932 up to nearly 100 000 hectares in 1934, and in 1937 reached 200 000 hectares The old main centres of production, *viz* , the centre, the north and the east, have very considerably increased their areas and cotton cultivation has also spread into other parts of Iran In 1934 the production statistics give for the first time separate figures for American and Iranian cottons, *viz* ,

American—63,269 hectares producing 67,940 tons of seed cotton

Iranian—33,068 hectares producing 34,648 tons of seed cotton.

The export figures for 1934 35 were —

4,000 tons Filestani priced at 4 98 Rial* per kilogramme

11,600 tons American priced at 3 90 Rial per kilogramme

11 000 tons Iranian priced at 2 75 Rial per kilogramme

In the year 1935 36 exports were —

5,000 tons Filestani priced at 4 3 Rial per kilogramme

6 400 tons American priced at 4 0 Rial per kilogramme

5 300 tons Iranian priced at 3 6 Rial per kilogramme

Filestani can be classed among the American sorts (long staple) It is derived from a cross between Egyptian and American cottons made by the owner Hakimy on the Filestani estate and is about 12 years old Every year it covers an increased area

Under the head Iranian is to be understood a form of *G herbaceum*, which has been in the country for many years and whose capsule does not open at the time of ripening and therefore requires only to be pulled off At the same time the fibres are shorter and the price therefore smaller A comparison of the figures of the two areas for 1934 would seem to show that the Iranian variety gives repeatedly better comparison, however, we should consider the areas where at least a thousand hectares of the one or the other sort is cultivated The following are the figures for the three main such areas —

Centre								
American .	13 880	hectares	=	14,771	tons	=	1065 kg	per hectare
Iranian	1,400	,,	=	1,505	,,	=	1075	Do
North								
American	27,700	,,	=	22 370	,,	=	807	Do
Iranian	6 000	,,	=	4 050	,,	=	675	Do
East								
American	10 204	,	=	11,654	,,	=	1142	Do
Iranian	10 483	,,	=	10 956	,,	=	1045	Do
Total average of the three areas								
American	51,784	,,	=	48 795	,,	=	942	Do
Iranian .	17,883	,,	=	16 511	,,	=	923	Do

*Rial=roughly two annas

The American kinds show a somewhat better yield per hectare. We can roughly take an average of a thousand kg. per hectare as the yield of either about 300 kg. being lint and 700 kg. seed. However, different prices are paid for the three kinds, both for export and in the inland market. We shall not take the very widely varying prices paid for export in 1934-35 but content ourselves with the figures paid in 1935-36. These were Iranian 3·60 Rial for kg. lint and American 4·15 Rial.

The money value of the cotton produced per acre is as follows :—

Iranian . . 300 kg. at 3·60 Rial per kg. = 1080 Rial per hectare

American 300 kg. at 4·15 = 1245 Rial per hectare

Similar differences appear if one compares the market prices at Teheran for seed cotton. In spring of 1937 these were as follows :—

Filestani . . 1·17 Rial per kg. = 1170 Rial per hectare.

American . . 0·97 Rial per kg. = 970 Do.

Iranian . . 0·70 Rial per kg. = 700 Do.

The management of cotton production including cultivation, working up of the harvested material, distribution and export lies in the hands of monopolistic company formed in August 1935. Cotton production in Iran has greatly increased due to the activities of this company. In the year 1937, it was expected that an area of 200,000 hectares would be cultivated.

Home (Iranian) requirements in the year 1312 were about 8,000 tons and have slowly risen. They were estimated at 12,000 tons in the year 1315 and about 14,000 tons for the year 1316 (1937). The home requirements ought to further increase when the spinning mills now in course of execution, start work. The following table shows the main customers for Iranian cotton in the last five years :—

	1310-11 (1931-32)	1311-12 (1932-33)	1312-13 (1933-34)	1313-14 (1934-35)	1314-15 (1935-36)
	Tons	Tons	Tons	Tons	Tons
Russia . .	28,160	9,490	9,840	19,820	13,990
Germany .	..	2,230	10,330	3,650	2,040
Japan . .	..	34	3,870	1,220	19
British India .	1,450	2,510	1,810	1,230	630

The total export for the last five years is 109,000 tons made up as follows :—

	Tons
Russia	81,300
Germany	18,250
Japan	5,143
British India	7,630

Of the 8,600 tons of cotton sent for export in the year ending 21st February 1937, over 90 per cent has gone to Russia According to the Customs report the prices move between 4 25 Rial to 5 30 Rial per kg The monthly Customs bulletin does not however show the kinds of cotton (this is only done at the end of the year) so that the differences in price are understandable On the other hand, for July-August, 1936, the following prices were noted for lint of the following qualities in the market of Teheran .—

Filestani	5 50	Rial per kg
American	4 67	Do
Iranian	5 67	Do

Cotton prices in the interior market are higher than the world prices obtained for export cotton

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THE FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

10TH CONGRESS

THE 10th Congress of the Far Eastern Association of Tropical Medicine will be held at Hanoi (Address "Igesante", Hanoi, Indochine) from the 24th to 30th November, 1938.

All licensed Medical, Dental and Veterinary practitioners are eligible for membership The membership fee for the period 1934 38 is £3 (or Rs 40 2) and should be paid to the Local Provincial Secretaries of the Far Eastern Association of Tropical Medicine, to whom the names of members in their areas should be submitted The members are also requested to inform the Local Secretaries whether they propose attending the Congress. The titles of any papers which it is proposed to place before the Congress should be submitted to the Local Secretaries at an early date Arrangements will be made for the reading at the Congress of any paper submitted by a member who is unable to attend

The Ninth Congress held at Nanking in 1934 decided that sections on Food Problems and Sanitary Measures with reference to Sewage and Garbage Disposal should also be added to the programme of the 10th Congress

Further information may be obtained from the Local Provincial Secretaries or from Lt Col G Covell, M D, D P H, D T M & H, F R E S, I M S, Director,

Malaria Institute of India, and local Secretary of the Far Eastern Association of Tropical Medicine for Government of India, Kasauli, Punjab, or the Honorary General Secretary, Far Eastern Association of Tropical Medicine, Parapattan 10, Batavia (Centrum) Java.

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THE EMPIRE JOURNAL OF EXPERIMENTAL AGRICULTURE

THE January 1938 Number of the Empire Journal of Experimental Agriculture again contains several articles of Indian interest, as will be seen from the list of contents reproduced below :—

The Application of Science to Modern Tea Culture, by P. H. Carpenter.

Manuring *Hevea*, II. Revision of Experimental Results by means of a Sampling Method for Yield, by W. B. Haines.

Cereal Grains as a Source of Nutritionally Useful Phosphorus, by L. C. Snook.

The Relation between Body-conformation and Productivity in the Cyprus Fat-tailed Sheep, by M. Finci.

The Relative Values of Organic and Inorganic Nitrogen Fertilizers, by A. H. Lewis.

Experimental and Statistical Technique of Some Complex Cotton Experiments in Egypt, by F. Crowther and M. S. Bartleet.

The Chemical Composition of the Grain and Straw of Varieties of Oats bred at the Welsh Plant Breeding Station, by W. M. Ashton.

Dicalcium Phosphate and Steamed Bone-flour as Supplements for a Phosphorus-deficient Ration, by W. Godden and S. C. Rây.

The Cattle of the Gold Coast, by J. L. Stewart.

The Potato Industry in Jersey, by D. Simpson and T. Small.

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RESEARCHES IN CHEMOTHERAPY

(Reprinted from *Nature*, September 4, 1937, with kind permission of the author, Dr. F. L. Pyman and the Editor, *Nature*).

CHEMOTHERAPY, which forms the subject of Dr. F. L. Pyman's presidential address before Section B (Chemistry), may be regarded as the treatment of disease by chemical substances, which have been shown by biological methods to be relatively much more toxic to pathogenic organisms than to human or other animal hosts.

Chemotherapy was developed by Paul Ehrlich, and its most outstanding achievement has been the introduction of the arsenic group of spirochaeticides

In the field of bactericides, the introduction of phenol as an antiseptic by Lister in 1867 has led to the study of many derivatives of phenol Recently systematic studies of various homologous series of phenols have resulted in the introduction into medicine of hexyl resorcinol and amyl *m* cresol, the latter having a Rideal Walker coefficient of 280

The chemotherapeutic investigation of amoebicides was greatly facilitated by the *in vitro* test for amoebicidal efficiency developed by Dobell and Laidlaw Using this test, Coulthard studied a series of alkyl derivatives of harmol prepared in Messrs Boots' Laboratories and showed that peaks of bactericidal efficiency were reached at butylharmol for *B typhosus* and at amylharmol for *S aureus* whilst peak amoebicidal activity was found in O *n* nonylharmol Salts of members of this series were, however, very sparingly soluble in water, and in order to obtain more soluble compounds the corresponding dialkylamino derivatives were prepared and their amoebicidal activities compared with that of emetine Although the most active member was not as active as emetine, it had several times the activity of O *n* nonylharmol and it was suspected that the harmol residue might not be the important contributor to the amoebicidal properties of the molecule and that the dialkyl aminoalkyl group might play an important part This led through various intermediate stages to the preparation and study of a series of tetra alkyldiamino paraffins and of these αx tetra *n* amyldiaminodecane was found to be the most efficient For brevity, the compound is referred to as T A D D

The preceding results had shown that, when tested by the Dobell and Laidlaw technique, T A D D was the most active amoebicide so far prepared It now became necessary to compare the efficiency of this compound with that of emetine under conditions as similar as possible to those found in the intestine of a dysenteric patient When tests were carried out under these conditions T A D D was found to be more active than emetine As originally pointed out by Ehrlich, the therapeutic value of a substance is a function of its toxicity to both parasite and human host It became necessary, therefore, to determine the relative toxicities of T A D D and emetine to mice The results of such a test showed T A D D to be from one third to one eleventh as toxic as emetine, depending on the method of administration

T A D D had thus a greater *in vitro* amoebicidal activity and was less toxic to mice than emetine These results appeared to justify the clinical trial of the compound in the treatment of amoebic dysentery

Such a trial was carried out by Prof Warrington Yorke, at the request of the Therapeutic Trials Committee of the Medical Research Council Unfortunately, T A D.D proved to be too irritant for parenteral administration and it was not sufficiently active to be of any real value when given orally

Whilst this investigation has not yielded a compound of clinical value, it has resulted in the accumulation of valuable data which will be of value in further work on this subject.

The account of such an investigation indicates the enormous amount of chemical and biological team work involved in attempts to evolve new drugs for the treatment of disease.

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THE MAYNARD-GANGA RAM PRIZE

Applications are invited for the "Maynard-Ganga Ram Prize" of the value of Rs. 3,000 which will be awarded for a discovery, or an invention, or a new practical method tending to increase agricultural production in the Punjab on a paying basis. The prize is open to all, irrespective of caste, creed or nationality and Government servants are also eligible for it. Essays and thesis are not eligible for competition and applicants should prove that some part of their discovery, invention, etc., is the result of work done after the prize was founded in 1925. The Managing Committee reserves to itself the right of withholding or postponing the prize, if no satisfactory achievement is reported to it. All entries in competition for the next award should reach the Director of Agriculture, Punjab, on or before the 31st December, 1938.

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The following communications have been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

WHEAT SOWINGS AND THE WORLD WHEAT OUTLOOK

The International Institute of Agriculture considers, on the basis of the information received up to mid-February, that the area sown to winters wheat in the northern hemisphere is almost as large as that sown last year which was the largest recorded. The Institute also reports that the sown area is particularly extensive, with few exceptions in the surplus producing countries, including, in particular, the United States, the U. S. S. R. and the Danube countries. The area of winter sowings in this group of countries is apparently at least as large as the second area of last year and much above the average of the years 1932 to 1936.

Reviewing the position of sowings and the present market situation, the International Institute of Agriculture considers that if the spring area in North America and the U. S. S. R. and the sowings in the southern hemisphere are not

considerably smaller, a very unlikely result, and if the average yield is not substantially below normal, the coming commercial year will be marked by rather considerable over production and an unstable position on the world wheat market

At present all that can be said on the outlook is that the condition of the winter crops is rather uneven in the United States, but generally satisfactory in Europe, the U S S R, India and North Africa

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WORLD SUGAR PRODUCTION AND MARKETS

THE International Institute of Agriculture gives the following information on world sugar production and markets

The production of beet sugar which is centred almost entirely in Europe, the Soviet Union and North America, appeared larger and larger as the manufacturing season advanced The season is now almost finished and it may be stated that the production of beet sugar in 1937 38 is the largest since the War, with the exception of 1930 31

The Soviet Union has a record production of about 2 5 millions metric tons of raw sugar, or 85 per cent larger than the average of the five years 1931 to 1935 The other European countries have for the most part shown increases ranging up to 50 or even 100 per cent above the average In spite of the rather unsatisfactory results in certain countries, the most important of which are France and Great Britain, the total European production of raw sugar is a million metric tons or 16 per cent higher than the average of 1931 to 1935

This result is due essentially to a heavy increase in beet production in the largest producing countries except France, namely in Germany, Czechoslovakia, Poland, and also to some extent to increases in certain minor European producers

The production of the two North American producing countries, United States and Canada, is very slightly below the average

The total world production of beet sugar including the Soviet Union, this year should exceed 11 million metric tons This figure is 0 9 million or 9 per cent larger than last year, and 25 per cent above the average of 1931 35, and is within 0 4 million of the record of 1930

In addition to this very large production of beet-sugar, it seems certain that there will also be an abundant production of cane sugar This year's production should be almost equal to last year's and exceed that of all earlier years

In short, the total production of beet and cane sugar in the 1937-38 season seems to be equal to or higher than the maximum reached in 1930-31.

This production may well disturb the world sugar market. Already a decline in sugar prices is reported, which is especially serious on the New York market, but was also appreciable in London and Prague at the end of 1937. Quotations of Cuban sugar on the New York Exchange fell in December 1937 to the average level of 1935 ; though prices were better maintained on other markets and were even at times high, the drop of American prices represents a serious symptom, which might reasonably cause fears of another crisis on the world sugar market.

Since May 1937, however, there has existed an agreement concluded at London between the great majority of producing countries, which aims at fixing the export quotas of producing countries for a period of five years ; it also covers the regulation of the free market between certain importing countries and their colonies or dependencies. It is designed in principle to maintain the equilibrium between the world supply and demand of sugar.

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THE PREPARATION OF THE SECOND WORLD AGRICULTURAL CENSUS

THE International Institute of Agriculture, which in 1930 organized the First World Agricultural Census, is now completing its programme for the Second Census to be taken in 1940.

For this purpose, in December last it assembled a conference of agricultural statisticians at which were represented the majority of the European countries and their colonies and several countries of other continents, together with the Secretariat of the League of Nations and the International Labour Office. The programme compiled from the suggestions of this Conference will be addressed to the Governments of all countries in the world to be put into practice, according to their particular conditions, in 1940.

The aim of the census is to ascertain agricultural production as accurately as possible, and, in general, to secure exact information on the agricultural and rural economy of the various countries of the world.

It is also of importance that each State should know the conditions of agriculture in the neighbouring countries and in the countries with which it has economic or commercial relations. It requires such knowledge in order to direct its foreign trade and to compare its own position with that of other countries.

To secure such knowledge, countries require a good periodical documentation on the agricultural utilization of land and on the characteristics of its exploitation and vegetable and animal production.

These considerations have already led a number of countries to undertake agricultural enquiries, more or less regularly, but these enquiries were conducted

at different times and with a great diversity of method The International Institute of Agriculture considered that it was of the highest interest to co-ordinate these efforts and the programme it has drawn up is designed to secure this co ordination, which, from the international point of view is indispensable

It believes, however, that the success of this second census depends on the co operation of Governments and also on the collaboration of agronomists, technicians and farmers of all countries

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SUPPLIES AND WORLD WHEAT REQUIREMENTS

The International Institute of Agriculture having revised, from the data and reports received since October, the statistical position of the present wheat season, publishes the following conclusions on supplies and world wheat requirements

World exportable supplies are estimated at 736 million bushels, or 34 million less than the forecast made in October They are very little larger than those of the last two seasons, which were among the lowest recorded for a long series of years Their smallness is due partly to the bad crops of Canada and Argentina and partly to the minimum exportable stocks with which the season began only about an eighth of the total surplus, or 88 million bushels, consists of stocks carried over from previous seasons, the remainder, supplied by the 1937 crop, being 648 millions

The probable requirements of importing countries stand, after revision at 520 million bushels, or 15 millions less than the October forecast, due to a decrease in the probable demand of Europe, which is reduced from 420 million bushels to 405 millions, while the probable demand of extra European countries is maintained at 115 million bushels At this level, world import requirements are, with those of 1935 36, the smallest since the Great War Against last year they show a decrease of 82 million bushels or 14 per cent

The figures of the wheat trade in the first six months of the present season, August 1937 to January 1938, show that net wheat exports from all the exporting countries were 266 million bushels, whereas the corresponding figure for the last season was 323 millions Imports of European countries in the same period were 192 millions against 180 last year, but they are forecasted for the second half season at 213 millions, compared with 258 millions in February—July 1937 On 1st February quantities afloat for Europe were larger than those at the beginning of the season (37 against 26 million bushels), but much lower than on 1st February 1937 (54 millions)

The predicted decline in international wheat requirements, which is confirmed by the trade movements of the first half of the season, is to be attributed in the

case of European importing countries to the large resources at their disposal, which reinforce their general policy of import restriction, and in the case of extra-European countries to the discontinuance of imports into the United States, Morocco and Tunisia following the good crops of 1937, in addition to smaller purchases by other large consuming countries (Brazil, China, Japan, etc.).

From a comparison of total import requirements of countries with a net import and the exportable supplies of those with a net export, it is apparent that the exportable surplus from the 1937 crop (648 million bushels) is amply sufficient, in spite of the failure of the Canadian and Argentine crops, to cover the forecast world demand (520 million bushels), so that, for the first time since 1930, a part of the exportable surplus (128 millions) will be held in reserve and carried over to next season. Accordingly exportable stocks, which after several years of steady decline were reduced on 1st August 1937 to a minimum level (88 million bushels), should on 1st August 1938 be about 216 million bushels, a slightly lower figure than was forecast for last October (235 millions) but still approximately equal to what was regarded as normal before the great wheat crisis.

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HANDBOOK OF COEFFICIENTS AND EQUIVALENTS: A STATISTICAL PUBLICATION OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

THE International Institute of Agriculture has just published a completely reset edition of its Handbook of Coefficients and Equivalents. (*Recueil de coefficients et d'équivalences*).

This small volume was originally produced for the use of the Statistical Bureau of the Institute in the conversion into metric units and *vice versa* of the data expressed in other measures, for the calculation of gold prices and similar purposes. Its usefulness proved much more general and it met with a cordial reception from statisticians and economists throughout the world, with the result that three subsequent editions, the last dating from 1922, were called for. The numerous changes in measures and monetary units, due not least to the unstable conditions in this field in the last decade, since then have made it necessary once again to bring the volume up-to-date. The opportunity has been taken not only to carry out a revision but to make a number of additions, both in the general information published and in the conversion tables.

The new edition, which has been completely reset and considerably enlarged, comprises 295 pages (*Recueil de coefficients et d'équivalences*, 295 pp., Rome, International Institute of Agriculture, 1937. Small 8°).

The first part gives the units of measure and their metric equivalents, monetary units, parities and approximate indication of actual exchanges for 116

countries The second part comprises 96 tables of equivalents for metric measures in British and American units and auxiliary tables for the conversion of sterling and rupee prices

The material is preceded by an introduction indicating the rules to be followed in making reductions, calculating percentages, indices, etc , and is followed by an analytical table and alphabetical index

In this new form the *Recueil de coefficients et d'équivalences* published by the International Institute of Agriculture is a very valuable tool for statisticians and economists throughout the world

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BULLETIN OF THE UNITED PROVINCES FRUIT DEVELOPMENT BOARD

Marketing Series

THIS bulletin is issued fortnightly by the Provincial Marketing Officer United Provinces Lucknow for the United Provinces Fruit Development Board Single copy As 2, annual subscription Rs 2 8 It is distributed free to the members the annual subscription for membership of the Fruit Development Board is Rs 10 The publication of this bulletin is part of the scheme prepared on behalf of the United Provinces Fruit Development Board The scheme consists of the appointment of subsidized commission agents in the important markets of the United Provinces on specified terms for the disposal of the fruits of the members of the Board The commission agents are required to deposit security to the Board as a guarantee of good faith and their work is supervised by three Marketing Supervisors and a Marketing Inspector under the control and general supervision of the Provincial Marketing Officer Orchardists will do well in joining the Fruit Development Board and making use of the facilities provided by it for marketing their produce

The bulletin gives wholesale and retail prices of fruits in some of the important markets of the United Provinces and other useful information such as trend of prices, demand, forecasts of crops, list of commission agents, weight of fruit packages, number of fruits in a container and the number of packages and quantity of fruit in a wagon load The bulletin serves as a good medium for advertising fruits and fruit plants

It is hoped that the example set by the United Provinces Fruit Development Board will be emulated in other provinces and states in India

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THE PUNJAB PROVINCIAL CO-OPERATIVE FRUIT DEVELOPMENT BOARD

THE Co-operative Fruit Development Board, Punjab, has issued a new series of bulletins dealing with fruit industry in foreign countries, namely, Egypt, Palestine, Italy, France and Switzerland. These bulletins are based on the notes taken by the author (S. Lal Singh, Fruit Specialist) during his tour in these countries from April to October 1934. The information contained will be found interesting by all lovers of fruit industry as different aspects of fruit culture of western countries are dealt with in a clear manner. The first few pages in each of these bulletins are devoted to the general information in regard to the area, population, status of fruit industry and various legislations passed to promote the general activities of the horticultural departments. This is followed by brief notes on the varieties of fruits grown in various localities, horticultural practices followed and hints on the cultivation of fruits as practised there. Nurserymen and horticultural departments desirous of introducing new varieties for trials would find in these bulletins sufficient information regarding varieties of fruits found successful as well as the characteristics of the same. The amount of money and labour spent on fruit industry in these countries is also given. This shows how much India is backward in this respect and how much more is needed to come to the level of development of these countries. The bulletins are well illustrated which makes them still more interesting. [R. L. S.]

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STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the "Monthly Statistics of the Production of Certain Selected Industries of India for September October November and December 1937."

Detailed statement of the quantity and description of jute manufactures produced in India

Description		Month of September 1936	Month of September 1937	Month of October 1936	Month of October 1937	Month of November 1936	Month of November 1937	Month of December 1936	Month of December 1937
I.—Twist and Yarn	tons	4 412	4 [illegible]5	4 397	4 311	4 [illegible]9	4 [illegible]09	4 816	5 095
II.—Manufactures—									
Canvas	tons	106	250	60	213	94	[illegible]16	165	201
	yds	214 117	584 857	118 743	484 411	183 641	458 518	34[illegible] 334	40[illegible] [illegible]09
Gunny Bags—									
(a) Hessian	tons	5 005	4 318	4 673	3 [illegible]02	4 83[illegible]	4 975	5 130	4 582
	No	10 442 1[illegible]1	8 592 215	10 396 451	8 092,394	11 239 065	16 [illegible]23 982	12 015 706	11 [illegible]27 815
(b) Sacking	tons	56 3[illegible]2	59 541	54 032	50 104	53 590	58 122	57 357	60 [illegible]81
	No	54 901 034	58 964 [illegible]92	52,01[illegible] [illegible]26	40 908 203	50 6[illegible]4 [illegible]82	56 900 [illegible]04	55 653 0[illegible]7	59 490 6[illegible]5
Gunny Cloth—									
(a) Hessian	tons	4[illegible] 804	44 639	42 005	38 3[illegible]6	40 601	43 442	42 009	44 661
	yds	164 602 649	171 8 8 889	160 540 064	143 808 605	154 336 0[illegible]	16[illegible] [illegible]40 839	165 0[illegible]6 [illegible]25	171 053 1[illegible]9
(b) Sacking	tons	2 285	2 [illegible]31	2 033	2 017	[illegible] 425	2 600	2 930	2 [illegible]
	yds	5 356 057	6 244 497	6 169 301	4 884 479	5 463 935	6 639 969	6 665 667	5 361 817
Other Manufactures including Rope and Twine tons.		508	384	5[illegible]3	348	84[illegible]	484	489	476
Total	tons	111 53[illegible]*	116,597	103 6[illegible]5*	99 111	106 763*	114 [illegible]18	11[illegible] [illegible]05	11[illegible] 601
	yds	1[illegible]0 1[illegible]3 [illegible]3*	1[illegible]8 684 243	166 937 193*	149 17[illegible] 495	159 043 [illegible]98*	1[illegible]4 330 3[illegible]6	1[illegible]2,084 3[illegible]8	176 8[illegible]
	No	63 [illegible]43,205*	6[illegible] 546 507	63 339 177*	54 930 [illegible]97	61 013 31[illegible]*	73 633 686	67 664 [illegible]	69 718 520

*Revised

Detailed statement of the quantity and description of sulphuric acid produced in India

Description	Month of September		Month of October		Month of November		Month of December	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Sulphuric Acid—								
(i) Ordinary or non-fuming	45,149*	40,158	54,702*	56,996	50,673*	52,485	13,223	52,034
(ii) Fuming	...	...	...	10	12	...	...	...

*Revised.

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of September		Month of October		Month of November		Month of December	
	1936	1937	1936	1937	1936	1937	1936	1937
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Ammonium Sulphate—								
Neutral	1,135	1,731	1,511	1,010	1,387	1,168	1,167	1,022
Acid	29	13	11	46	38	13	18	35

Detailed statement of the quantity and description of sugar produced in India

Description	Month of September 1936	Month of September 1937	Month of October 1936	Month of October 1937	Month of November 1936	Month of November 1937	Month of December 1936	Month of December 1937
	Cwts	Cwts	Cwts	Cwts	Cwts	Cwts	Cwts	Cwts
(i) *Khandsari* Sugar*	588	937	1 [illegible]	168	1 060	1 674	3 [illegible]98	3 410
(ii) All other Sugar except Palmyra Sugar	135 361	100 4[illegible]9	149 231	120 149	581 907	311 740	3 [illegible]23 242	[illegible] [illegible]33 758
(iii) Palmyra Sugar	33 059	17 314	31 [illegible]05	6 510	27 096	9 609	22 [illegible] 8	9 [illegible]44
Total	169 008	118 730	182 613	1[illegible]6 827	610 063	323 023	3 249 818	2 [illegible]46 412

* Figures relate to excised issues only

Detailed statement of the quantity and description of wheat flour milled in India

Description	Month of September 1936	Month of September 1937	Month of October 1936	Month of October 1937	Month of November 1936	Month of November 1937	Month of December 1936	Month of December 1937
	Mds	Mds	Mds	Mds	Mds	Mds	Mds	Mds
Flour	503 150	567 143	538 445	594 688	4[illegible]0 491	569 587	541 899	605 881
Atta High grade	288 [illegible]35	324 654	313 0[illegible]7	356 215	274 066	305 038	299 380	310 220
Atta Low grade	147 254	215 980	176 [illegible]60	212 6[illegible]0	16[illegible] [illegible]09	238 [illegible]83	186 690	257 182
Bran	220 234	2[illegible]6 063	243 984	205 259	202 467	2[illegible]0 041	2[illegible]8 [illegible]	[illegible]81 067
Soojee	53 9[illegible]0	88 058	[illegible]4 [illegible]44	113 31[illegible]	59 059	80 047	64 548	[illegible]0 498
Others	7 405	10 607	16 214	11 348	5 000	13 812	7 1[illegible]6	16 804
Total	1 [illegible]0 286*	1 482 505	1 364 124*	1 [illegible]83 492	1 173 [illegible]2*	1 486 308	1 3[illegible]8 460	1 [illegible]41 602

* Revised

ABSTRACTS

Studies in plant breeding technique, III. Crop analysis and varietal improvement in Malvi *jowar*, J. B. HUTCHINSON, V. G. PANSE, N. S. APTE and B. M. PUGH. (*Ind. J. Agric. Sci*, 8, *131*).

THE present status of *jowar* in Central India has been surveyed and the possibilities of crop improvement by selection studied.

Snowden's classification is shown to be inadequate to the needs of agricultural botany. The *jowars* of Central India are assigned to one of his main groups (*Sorghum durra* Stapf), and it is shown that the limits of at least three of his species in this group are transgressed in the single, variable, inter-breeding crop population.

Results of a crop analysis carried out in Malwa and Nimar are described and compared with those obtained from a similar study on cotton by Hutchinson and Ghose.

Two years' mass selection had no appreciable effect on the yield of Malvi *jowar*.

Progeny row work was carried out in replicated randomised blocks as described by Hutchinson and Panse. Large and highly significant differences in yield between progenies were demonstrated in each season and three strains, one significantly superior to the local in yield and the other two of considerable promise, were isolated. It is suggested that the plant breeder should endeavour to retain as wide a range of material as possible in " small bulks " trials to improve his chances of discovering some strains superior under all environmental conditions. (*Authors' abstract*)

Micro-climatology of an irrigated cotton field in Sind. B. M. DABRAL and S. S. CHINEY. (*Ind. J. Agric. Sci*, 8, 161).

TEMPERATURE and relative humidity inside the cotton crop grown under irrigated conditions in Sind were recorded periodically by means of an Assmann's Psychrometer, the results of which are presented and discussed in this paper.

The micro-climate inside the developing crop of cotton, when compared with the ordinary air conditions prevailing outside, differs in many respects. Outside factors exert the basic pull on all situations, but the periodicity of irrigation to the crops acts against this pull and modifies the crop environment considerably. When the crop has attained its maximum size, the crop environment inside, assumes the nature of a perpetual cloudy weather. The temperature and relative humidity inside a crop are farthest away from the normal just after an irrigation. As the soil underneath the crop dries, inside conditions tend to approach those obtaining outside,

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till again deflected widely by another irrigation This super imposes a periodicity over the normal daily and seasonal trends of climatic variations of a locality.

The growing plant thus experiences a variety of climatic conditions during its life Apart from the daily weather changes, the frequency and the quantity of irrigation has the most dominating influence on the climate inside and over a crop specially in an arid tract like Sind The shade of the crops creates a separate environment for such organs of the plants as lie inside, while their top and sides which get direct sunshine for varying periods of time during the day, experience altogether a different kind of climatic conditions (*Authors' abstract*)

Some leaf diseases of *Hevea brasiliensis* new to India. M MITRA and P R MEHTA (*Ind J Agric Sci* **8**, 185)

A DISEASE of young leaves of rubber plant (*Hevea brasiliensis*) was reported early in 1936 from a plantation in South Travancore. It was noticed to do a good deal of damage at the time of annual refoliation and was accompanied by abnormal leaf fall The young leaves were free from spots but badly shrivelled, while the mature leaves were badly spotted The cause of the disease seems to be *Oidium heveae* Steinman and *Gloeosporium alborubrum* Petch Another fungus isolated from the diseased leaves was *Colletotrichum ficus* Kds with its perfect stage *Glomerella cingulata* (Stonem) S. and V S These fungi have not been recorded previously from India on *Hevea brasiliensis* (*Authors' abstract*)

Some experiments on the carotene content of grasses and concentrates and the feeding of Guinea grass to dairy cows. J K MAKHIJANI and B N BANERJEE (*Ind J Vet Sci & Anim Husb* **8**, 13)

THE carotene content (carotinoid pigment after separation of chlorophyll and xanthophyll) of seventy three samples of grasses, hays, and other fodders, has been determined In the mature green stage, grasses contain 18 to 56 mg Silage of Guinea grass contains only 4 mg, while the grass itself contains 50 mg Maize, *bajri*, and *ragi* at the flowering stage contain 24 to 96 mg but in the straw or fodder stage, very little Legumes like *kulthi*, *methi*, soya bean cowpea, peas, and *karai* contain 98 to 182 mg Lucerne 164 and Paspalum 260, are very rich sources for carotene Dry grasses from forest areas and hays and straws are very poor in this respect Of the fifty two concentrates examined, most of them contained nothing or at the most traces in a few samples By increasing the proportion of guinea grass (carotinoid feed) it is possible to increase the carotene content in the blood and milk of cows. The vitamin A content of the butterfat is, however, not materially altered (*Authors' abstract*)

'Soil conservation districts'. D. S. Myer. (*Agricultural Engineering*, March 1938, Pp. 111 to 113).

(D. S. Myer is the Chief of the Division of Co-operative Relations and Planning Soil Conservation Services, U. S. Department of Agriculture and he presented this paper before the Soil and Water Conservative Division at the meeting of the American Society of Agricultural Engineers at Chicago, December 1, 1937).

Erosion can be controlled effectively only by treating each bit of land according to its own needs and adaptabilities. Steep or highly erodible land should generally be planted to a growth of trees or shrubs ; intermediate areas in permanent pasture ; crop production should be confined to those parts of the farms where erosion can be checked by rotations, engineering devices and proper methods of cultivation. The ideal is a proper combination of agronomic measures, simple engineering structures and approved methods of forestry. Programmes of this general type are being carried out in co-operation with the Soil Conservation Service by more than 50,000 farmers and ranchers. Each of these areas was selected to typify a broad surrounding agricultural region. The demonstration operations are not intended as a complete solution to the erosion problem but merely as guide posts helping to point the way to solution. They cover something less than 3 per cent of the total agricultural area in the U. S. A. Yet it is estimated that 75 per cent of this area is either actually or potentially subject to some form of erosion damage. There is real need of a mechanism whereby erosion control measures which have proved effective can be applied over considerable of our erodible land. In the first half of 1937 the legislatures of twenty-two American States passed enabling laws setting up state soil conservation committees and permitting the formation of local districts for the purpose of controlling erosion. These enactments are of a democratic character. Actual organisation of a district can come only after public hearings have been held and at least a majority of land occupiers, voting in a referendum, have signified their approval. Once created, the district is governed by a board of five supervisors, three of whom are elected by local balloting and two appointed by the state committee. But no important step in procedure can be taken without consulting the will of the majority of land occupiers themselves, and numerous safeguards are provided to protect the individual against any possible injustice. Once organised, the district functions as a Governmental sub-division of the state with all the privileges ordinarily pertaining to such units. The district may conduct erosion control projects. It may enter into contracts with individual farmers and assist them in the formulation of soil conservation programmes and the adoption of erosion control practices. It is almost inevitable that in the near future a large number of districts will turn to the Soil Conservation Service for aid and advice. The experience gained by this Service from operation of the demonstration programme over a four-year period combined with the knowledge obtained by other agencies, has crystallized into a comprehensive fund of practical information on soil and water conservation. The Service will fully co-operate with those districts which approach the problem of erosion control in an effective manner. The precise form of this co-operation cannot be established until an adequate background

of experience has been acquired The amount of the Service's aid to a particular district will probably be determined to some extent by the programmes and work plans which are adapted In general, the Service will provide a certain amount of technical assistance Technicians released from project duty under the Service, will be made available to districts as they are needed In certain cases monetary grants or other services may be given, e g , construction supplies or planting stock of new or uncommon varieties of erosion resistant vegetation In all cases the total amount of such contributions should be matched by state or district funds made available for erosion control purposes The policy relating to this type of supplemental service has not been fully worked out Under the district, the District Supervisors are responsible for the adoption and carrying out of programmes and work plans within the area Other important pieces of land conservation legislation by the U S Federal Government are the following —

(1) The Flood Control Act of June 1936 which is significant in relating the problem of flood control with that of land use

(2) The Water Facilities Act passed at the last session of the Congress which links up the problem of land use with that of water conservation Under it the Department of Agriculture is authorised to develop and carry forward a programme for the conservation and utilisation of water in arid and semi arid states It is recognised that the success of all these movements depends very largely on the whole hearted co operation of all interested national, state, and local agencies, both governmental and private (*B B*)

A note on a new method of control for insect pests of the cotton plant.
T G Mason and E Phillis (*Emp Cotton Growing Rev Vol XLV, No 4*)

Following certain observations by Hurd Karrer on the toxicity of selenium and selenium containing plants to aphids, the authors have tried out the possibility of using selenized cotton plants as a trap for cotton stainers and pink bollworm Trials with cotton plants grown in sand cultures, on nutrient solutions containing different concentrations of sodium selenate, showed that growth was strongly depressed when the concentration exceeded 50 p p m During growth it was noticed that the selenized plants were not repellent to the aphids, but that the infestation on such plants was at a much lower level than on the control ones The feeding of cotton stainers (*Dysdercus Howardi* B) with the green bolls of selenized plants resulted in the death of all the insects in those cases where the selenium concentrations were 10,20 and 50 p p m and 60 per cent of the insects where the selenium concentration was 5 p p.m It was, however, found that as development proceeded the stainer became more resistant to selenium poisoning Similar experiments with pink boll worm were less conclusive owing to the difficulty of breeding them in captivity but they showed that though the moths were not repelled by the selenized plants, there was considerable mortality in such bolls (*P. S S*)

The application of science to modern tea culture. P. H. Carpenter, Chief Scientific Officer, Indian Tea Association. (*Emp. J. Expt. Agric. Vol. VI, No. 21*).

The adoption of scientific methods by tea industry may be said to have begun in the present century. Mann in studying the problems of North-east India quickly realised that one of the main troubles was the loss of soil fertility and the inability of the deteriorated soil to supply the necessary quantity of nitrogen to the bushes. The supposition that the use of artificial nitrogen on tea soils exhausts the soil of organic matter is the reverse of the truth. Results of the experiments conducted at Tocklai made it clear that at any rate for tea culture there might be no fear that the use of an inorganic manure such as sulphate of ammonia would deplete the soil of organic matter so long as the tea prunings are incorporated in the soil. It would also seem that incorporation of this kind of organic matter as prunings into the soil is sufficient for soil requirements and consequently no gain in crop is obtained by the use of bulky organic manures. Experiments have shown that for the same application of nitrogen cattle manure possesses about $\frac{1}{2}$ to $\frac{1}{3}$ the efficiency of sulphate of ammonia. The tea crop and the quality of the finished tea can be maintained by the use of moderate annual application of nitrogen only which can most efficiently be given in the form of sulphate of ammonia up to a maximum of 300 lbs. per acre. This result has made it to reduce the cost of the manurial programme by about 25 per cent or more—a very valuable saving under conditions that impose strict economy.

The use of phosphatic manure either alone or in conjunction with other manures has so far found to have little effect on the crop. The use of potash as a manure has shown conflicting results. It has improved the quality in Ceylon but has deteriorated it at Tocklai. These apparently contradictory results may be due to the difference in the amount of potash in tea leaves at the two places.

The results of cultivation trials indicate that for tea (a perennial crop) annual soil stirring does not appear to be necessary. Although such a method as hand-weeding and entire suppression of weeds can be practised satisfactorily on flat lands it has been found to result in soil erosion on slopes.

It is in the direction of variety selection and production of uniformity in the progeny of tea seed-gardens that the next big development in tea culture is likely and the importance of research in this direction is now recognised throughout the industry. The progeny of all seed-gardens is much hybridised and it is evident to any casual observer that the plant raised in any one seed-garden gives progenies which differ considerably among themselves in appearance. A very great improvement would result if uniform characteristics could be achieved in the product from any one seed-garden. The work of vegetative reproduction by breeding and selection of bushes for some desirable quality is in progress in Java, Russia, Tocklai and Ceylon.

In pests and diseases the recognition of root disease causing the death of bushes has resulted in the adoption of methods to prevent it from spreading. The study of disease organisms has greatly decreased the casualties. Leaf diseases are controlled by systematic spraying and pruning. The disease that enters through pruning-cuts is still a difficult and as yet an insoluble problem. The problem that is still

serious is how to treat rotting pruning cuts on old bushes, so far no satisfactory solution has been found

On the manufacturing side three theories of tea fermentation, *i e*, (1) that it is purely a chemical reaction (2) that the reaction depends upon the presence of enzymes naturally present in tea leaves and (3) that that enzymes exist in the cells of micro-organisms but not in the cells of tea leaves have received attention For a long time it has been evident that none of these theories can satisfactorily explain all the happenings in the factories but it is now appreciated that both the enzymes *i e*, of the tea plants and of the micro organisms may be active in tea factories Chemical analysis has revealed the important effect that the constitution of the tannin found in tea differs from that of digallic acid (tannic acid of the British Pharmacopea) This discovery is of much importance for it is no longer permissible to attribute the physiological reaction or digallic acid to the tannin of tea This has often been done in the past by medical men and has led to much misrepresentation in regard to tea drinking (*R L S*)

Manuring *hevea*, II. Revision of experimental results by means of a sampling method for yield. W B HAINES Field Research Officer, Dunlop Plantations, Ltd (*Emp J Expt Agric Vol VI, No 21*)

A NEW system of recording yield by a sampling method has been introduced in the Dunlop manurial experiments on rubber which has improved the reliability by avoiding certain human sources of error and has increased the detailed information obtained The older method was designed with the main object of fitting in with ordinary estate routine Plot sizes were arranged to correspond with tasks and the collection and carrying of latex samples was left to the tappers who had no appreciation of the experimental requirements In the new method these weaknesses have been removed An independent proportional random sample of trees is taken on certain days and the yields are recorded by a special man who does all the work of collecting coagulating and weighing the latex properly Blocks of treatments are dealt with in one day, so that day to-day change (weather) is eliminated with blocks in the analysis The method by giving individual tree yields is eminently suitable for following through the interesting details of yield reactions during wintering periods when abnormal yields or rapid changes occur The data collected well illustrates greatly extended information made available by the new method of recording

The new results recounted refer to the eleven 25 plot experiments described in the previous paper where the results extended to the end of 1931 the fifth year of action of the manures The present account covers yield taken between May and October 1937, the seventh year of manuring The changes shown are therefore a combination of the advance in the field responses and of such corrections as the improved technique of recording has introduced The data cannot be regarded as definitive but they are of sufficient volume and consistency to establish a new interpretation The new figures show in every case significant increases due to manuring The average

effect of the complete inorganic fertiliser is significantly greater than that for any other treatment. The superiority of this over sulphate of ammonia is distinctly established in six cases out of eleven. One must therefore revise the conclusion expressed in the previous paper that complete inorganic fertilizer and sulphate of ammonia were for practical purposes nearly equal. In the past there was a tendency to represent the yields from all manured plots as more uniform than the facts warranted.

In regard to the economics of treatment the average of all the experiments indicates a very wide margin of profit from the treatment with sulphate of ammonia (70 to 80 per cent). The complete inorganic and the NK treatments give a small margin only whilst the organic mixture is too costly for any profit. Nitrogen can be given as the chief requirement with the least risk of extravagance and the best times and amounts of mineral additions leave much room for conjecture though their ultimate value seems clearly established.

Progress has also been made in the interpretation of the effects of the manures on growth. The previous paper suggested a girth increment rate of 0·5 in. per annum as a standard below which need of manuring would be in much evidence. It would now appear that a good response has been shown in experiments where the control has not fallen so low and the suggested standard may be raised to 0·7 in. per annum. A rough rule to be used in conjunction with other field observations is also indicated, *i.e.*, starved conditions may be presumed if the growth rate has fallen much below half the average rate since planting. Measurements of growth and of bark-thickness serve to indicate the gross improvements produced by manuring, but they are not sufficiently closely correlated with yield for serving to distinguish between cases of restored rubber, that is, for comparing the relative powers of different fertilisers to increased production. (*R. L. S.*)

The relative values of organic and inorganic nitrogen fertilizers. A. H. Lewis, I. C. I. Agricultural Research Station, Jealott's Hill, Bracknell, Berks. (*Emp. J. Expt. Agric. Vol. VI, No. 21*).

The experimental work described consists of two parts. In the first part the results of a field experiment which was conducted at Datchet, Bucks, on the same site in 1934 and 1935 on alluvial soil in typical market garden conditions are described. The crop used in this experiment was Brussels sprouts. In the second the results of a parallel pot culture experiment which was conducted in glazed pots, using as growth medium a mixture of soil from the experimental field at Datchet and sand are given. White mustard (*Sinapis alba*) was used as the test plant in the first year, several immature crops being harvested to study uptake of nitrogen in the early stages of the experiment. Barley and wheat were used in the second and third years. The treatments were the same as in the field experiment with the addition of urea and ammonium nitrate. The term 'organic nitrogen fertilizers' in this experiment mean those materials of plant or animal origin which contain a fairly high proportion of plant nutrients and can thus be classified as fertilizers. Bulky organic materials of low

analysis such as farmyard manure, do not come in this category The results of experiments to study the relative effects of organic and inorganic nitrogen fertilizers under these two conditions show that organic nitrogen fertilisers are not superior to inorganic nitrogen fertilizers in crop producing power There is no evidence that organic nitrogen fertilizers have any value beyond that to total nitrogen content. The evidence shows that provided that the lime status of the soil is maintained at an adequate level, inorganic nitrogen fertilizers will give at least as good results as organic fertilizers supplying the same amounts of nitrogen

The main claims of the superiority of organics in (1) the slow release of available nitrogen (2) as a source of humus and thereby improving the physical condition of the soil and (3) containing specific beneficial substances, e g , hormones are explained in the discussion in the end as of no special advantages over the inorganics (*R I S*)

Experimental and statistical technique of some complex cotton experiments in Egypt. F CROWTHER and M S BARTLETT, Imperial Chemical Industries, Ltd (*Emp J Expt Agric Vol VI, No 21*)

THE experimental and statistical technique used in a series of complex cotton experiments carried out in Egypt during 1934 36 is discussed in relation both to the objects of the research programme and to the particular conditions determining field experimentation on the cotton crop in Egypt The experiments were limited in the 1934 season to simultaneous comparison of the four factors, variety, spacing, nitrogen and water supply In 1935 phosphate generally replaced water as the fourth factor As the information from the experiments proved consistent, in 1936 the investigations were extended to include such factors as date of sowing and date of fertiliser application

Statistical aspects of the results considered include figures on the relative accuracy of main and sub plot or of partially confounded to completely randomized lay-outs, and the correction for damage due to salt accumulation in the upper layers of the soil for three of the 1936 experiments The variation in fertility throughout the site in three representative experiments is illustrated Salt accumulations in the upper layers of the soil can be very serious in Egypt owing to the harm done to the crop Such salt accumulations are produced by inadequate drainage of sub-soil water the salt moving upwards in the wet soil and accumulating on the ridge above the level reached by the irrigation water If this accumulation is severe early in the season the young cotton plants die The occurrence of salt is so wide-spread that any series of experiments if representative must include some experiments in which the yields of some plots are reduced by salt damage The exact type of lay-out decided on is necessarily a problem demanding some deliberation depending both on practical and theoretical considerations No lay-out, however, will eliminate the extreme patchiness and the need for care in the choice of an experimental site is indicated (*R L S*)

The following abstracts of articles from the *Indian Forester* have been received from the President, Forest Research Institute, Dehra Dun, and are published here as they are of interest to agricultural workers :—

Regeneration and propagation of sandalwood. S. Rangaswami. (*Ind. For.* XLIII (8) : 522-37, 1937).

Natural reproduction of sandal; general seasons of seeding and the seeding capacity have been discussed.

The causes for the absence of seedling growth in certain localities have been traced to seed destruction by various agencies especially rodents.

Natural spread of sandal in Salem North Division since 1869 has been worked out. The importance of seed selection by natural agencies such as birds, animals, etc., pointed out. Various artificial methods of sandal propagation have also been described and the merits of artificial regeneration from nursery-grown plants by different methods over direct sowings have been indicated. (*S. Rangaswami*)

Note on sandal growth in Coorg. J. E. M. Michell. (*Ind. For.* LXIII (9) : 583-87, 1937).

Of the sandal trees in Coorg, only 8 per cent are in the forest reserves, the remaining 92 per cent are in estates outside that have been subjected to frequent fires and damage by villagers. Yet recent enumeration figures indicate that many of the trees have managed to survive to over 15 in. girth and the possible explanation is that either natural regeneration is profuse or light fires stimulate growth. The argument that trees found in rich soils of the semi-ever-green type do not contain as much heartwood as those on poorer soils of the deciduous forests is open to question. Systematic tending and precautions against fire in dry weather might improve stocking in relatively good sandal areas. (*M. V. Laurie*)

Note on the comparative strengths of sapwood and heartwood. H. Trotter. (*Ind. For.* LXIII (9) : 598-600, 1937).

Shows that for all practical purposes the difference between the strengths of heartwood and sapwood is negligible. (*H. Trotter*)

Departmental collection of Kulu gum (*Sterculia urens*) in Damoh division. Kesar Singh. (*Ind. For.* LXIII (7) : 449-55, 1937.)

As a result of defective tapping resulting in a large number of trees being killed and of poor financial results, it was considered necessary to replace the lease system by departmental collection in January 1935.

In the year 1934 35, 297 maunds of gum was collected for Rs 1,316 This quantity was sold for Rs 3,165, giving a net profit of Rs 1,849 In the year 1935 36, 1 604 maunds of Kulu gum was collected for Rs 5,113 which was sold for Rs 11,868 giving a profit of Rs 6,755

The most suitable dimensions of cuts are 6 inches by 18 inches, but this requires further investigation.

The average yield per tree comes to one seer (i e, 2 2 lbs) per year (*Kesar Singh*)

Seed origin and its importance in Indian forestry. M V LAURIE (*Ind For* LXII (1) 18 22, 1936)

THIS article, in reply to a previous article by K D Joshi, reviews investigations at present in progress in India with regard to seed origin The present lack of control over the source of seed used in artificial regeneration work is emphasised and suggestions made for certifying the origin of all seed supplied departmentally A classification of the different types of characters that may be inherited is given Special mention is made of the effect of size of seed in teak and other species on germination and subsequent development The question whether provincial seed testing stations could perform any useful function is discussed, and the impossibility of such stations exercising any check on the hereditary suitability of seed is mentioned (*M V Laurie*)

Porcupine-proof fencing. E C MOBBS (*Ind For* LXII (11) plate 1, 676 81, 1936)

DESCRIBES experiments with different gauges, mesh, height and depth of burying or width of layering along the ground for wire netting fences against porcupines Layering was found useless A fence of 18 gauge, 1 inch mesh 4 feet wide fixed vertically with 1½ feet above ground is recommended (*M V Laurie*)

Regeneration of frost-liable forests in the Central Provinces. K P SAGREIYA (*Ind For* LXIII (9) 578 79, 1937)

ON the presumption that frost bite in plants is caused when temperature of the surrounding cold air falls below a certain level, the writer suggests a method of preventing frost by inducing circulation of the stagnant cold air by cutting a series of strips across the frost liable depression running in the direction of the prevailing wind in the locality (*K. P Sagreiya*)

Results of coppicing, pollarding and pruning experiments to stimulate Strychnos nux-vomica fruit production. J. W NICHOLSON. (*Ind. For.* LXIII (9) : 588-97, 1937).

THE yield of *kuchila* seed is proportionate to the size of the tree. (2) Coppicing or pollarding trees reduces the size of the tree and causes a loss in seed production which is never likely to be made up. Pruning has the same effect but to a lesser degree. (3) Coppicing very young trees may result ultimately in their acquiring crowns of fuller spread than if they were left to grow naturally, but trees tend to develop spreading crowns as soon as height growth starts falling off, artificial measures to promote crown spread are therefore not likely to be worthwhile. (4) The yield of seed from individual trees fluctuates remarkably from year to year. Drought or fire, especially the latter, cause a subsequent drop in yield. (*J. W. Nicholson*)

REVIEWS

Scientific Horticulture (Formerly the H. E. A. Year Book). The Journal of the Horticultural Education Association. Vol. VI 1938. (Price 4s net, 4s 6d by post, obtainable from the Editor, Scientific Horticulture, South Eastern Agricultural College, Wye, Kent England)

THIS volume, like its predecessors, is of a high standard and full of information Pages 17 to 159 contain seventeen papers read at the Third Revision Course in Horticulture at the University of Reading from September 14 to 17, 1937 There are eight other papers of which three give a clear concise account of some scientific subject closely connected with horticulture These are —

External Organic Growth promoting Substances and Green Plants by M Thomas

Boron Deficiency in Horticultural Crops Recent Developments by A W Greenhil, and

Chromosomes and their Importance in Horticulture by F W, Sansome

The last named will be specially useful to those who have read a little elementary genetics such as given in Punnet s " Mendelism " It is particularly worthy of notice by anyone who teaches plant genetics Incidentally it may be remarked that all the worth while teaching of plant genetics in India is done in certain of the agricultural colleges or in the Imperial Agricultural Research Institute The Book Reviews and Notices at the end give a conspectus of some recent important horticultural literature [W B]

Potash Deficiency Symptoms (Kennzeichen Des Kalimangels, Signes De Manque De Potasse). By PROFESSOR DR AGR H C OSKAR ECKSTEIN, ALBERT BRUNO and DR J W TURRENTINE, with the collaboration of G A COWIE and DR G N HOFFER, published by Verlagsgesellschaft Fur Ackerbau M B H Berlin, S W II, 2nd Edition, 1937 (Price not stated)

THIS sumptuous volume is written throughout in three languages and has nearly half its bulk taken up by beautifully coloured illustrations indicating visually the effects of lack of potash in certain crops There are also various uncoloured photographs in the text and a diagram indicating in kilogrammes per hectare, the amount of plant food removed from the soil by average crops There is a

foreword by M. Gabriel Bertrand, Member of the Academy of Sciences of France and of the Academy of Agriculture, who introduces the three main authors as follows :—

"Prof. Oskar Eckstein, formerly of the Faculties of Science of the Universities of Chicago and Peking, directs the scientific activities of the German Potash Syndicate. He is the author of numerous chemical and agricultural papers. His department edits the review 'Die Ernahrung der Pflanze' and includes the unusually well equipped Agricultural Experiment Station at Berlin-Lichterfelde, both well known throughout the agricultural world.

M. Albert Bruno, Ingénieur Agronome, is the director of the Scientific and Agricultural Service of the Société Commerciale des Potasses d'Alsace. After twenty years of activity in the laboratories of the French Ministry of Agriculture, he was appointed to the post of Director of the Central Laboratory of this Ministry and was entrusted later with the supervision of the whole service. After the war Mr. Bruno devoted a great part of his energies to the reorganization of the official agricultural stations. In 1927 he was delegated by the Ministry of Agriculture to take over his present position with the French potash mines.

Dr. J. W. Turrentine was formerly in-charge of Potash Researches of the Bureau of Chemistry and Soils, United States Department of Agriculture. His book 'Potash' published in 1926 gives a review of the world's potash situation at that time. The different groups engaged in the exploitation of American salt lakes and mineral deposits and in the importation of potash salts to the United States have recently founded a joint research and educational service under the name of American Potash Institute and Dr. J. W. Turrentine was selected as its president."

After the introduction, the first part of the book deals with general symptoms of potash deficiency, under which there are four sections :—

(1) External symptoms and modifications of the inner structure of the plant,

(2) secondary effects of potash deficiency,

(3) potash deficiency and the market value of crops,

(4) pathology of potash deficiency.

The second part deals with potash deficiency symptoms of various cultivated crops including—

(*a*) maize and other cereals,

(*b*) fruit trees,

(*c*) vines.

There is a useful bibliography of 209 titles.

There are persons both lay and scientific, who have a tendency to regard any publications connected with commercial companies producing or selling artificial manures as necessarily biased and therefore to be regarded as propaganda.

A scientist, at least, ought to be able to approach any statement of experimental results both critically and objectively and those who can do so will find in the volume under review a mine of information and a whole series of indications which will be of undoubted assistance to them in planning their own laboratory and field experiments

There is still much to learn with regard to the role in plant life of even those chemical elements known to be of first importance and a summary like this book, particularly when reinforced by the admirably coloured plates, is a valuable synopsis of a great deal of carefully documented experience [H B]

The Punjab Fruit Journal (Annual Number). Available from the Punjab Fruit Development Board Lyallpur. Price Re 1 for casual purchaser and Rs 2 for annual subscribers for this and other copies published during the year

The first Annual Number of the Punjab Fruit Journal which has just been published, is undoubtedly a valuable addition to the agricultural and horticultural literature of the country It has an extra large number of articles of great interest both in the English and vernacular sections

The English section, in addition to the usual interesting pages of news, comments and seasonal hints, contains no less than fifteen articles on some of the most interesting and vital aspects of the fruit industry of the country Important among these are Obstacles in the Fruit Preservation Industry, Cultivation of Apples and Cherries in the Simla Hills, Improvement of Mangoes in the Punjab, Canning of Fruit Juices, Cold Storage Cultivation of some Minor Economic Crops like Coriander, Fennel (*sonf*), *Ajwain*, Dill, Henbane, Rosha grass, Liquorice (*mulathi*) Isabgol, etc , and a large number of extracts and abstracts from leading foreign periodicals A comprehensive fruit marketing scheme for improving the marketing of fruits is yet another valuable contribution to this issue

The Urdu section has also been specially enlarged and contains about forty pages comprising of articles such as commercial aspect of fruit gardening, seasonal hints, a general horticultural guide, propagation of mangoes, and several other important articles on the control of diseases and pests of fruit trees A comprehensive resume of results of experiments conducted on citrus fruits in the Punjab of over ten pages under the joint authorship of the Fruit Specialist and the Assistant Fruit Specialist, Punjab, is a special feature of this section

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NEW BOOKS

On Agriculture and Allied Subjects

The Microscope : Theory and Practice. By Conrad Beck. (London : R. and J. Beck, Ltd., 1938.) Price 7*s*. 6*d*. net.

Entomologic. 8vo. By W. Speyer. (Dresden und Leipzig : Theodor Steinkopff, 1937.) Price 13 gold marks.

The Observer's Book of Trees and Shrubs of the British Isles compiled by W. J. Stokoe. (London, New York : Frederick Warne and Co., Ltd., 1938.) Price 2*s*. 6*d*. net.

Marine Algae of the North-eastern Coast of North America. By William Randolph Taylor. (University of Michigan Studies, Scientific Series, Vol. 13, Ann. Arbor. Mich. : University of Michigan Press, 1937.) Price $5.

The Practical Book of Garden Structure and Design. By Harold D. Eberlein and C. Van Dyke Hubbard. (Philadelphia and London : J. B. Lippincott Co., 1938). Price 21*s*. net.

Plants for the Connoisseur. By Thomas Hay. (New York and London : Putman and Co., Inc., 1938). Price 10*s*. 6*d*. net.

Mother Earth : being Letters on Soil addressed to Prof. R. G. Stapledon. By Gilbert Wooding Robinson. (London : Thomas Murby and Co., 1937). Price 5*s*. 6*d*. net.

A B C of Agrobiology : the Quantitative Science of Plant Life and Plant Nutrition, for Gardeners, Farmers and General Readers. By O. W. Willcox. (London : George Allen and Unwin, Ltd., 1938.) Price 12*s*. 6*d*. net.

Phytohormones. By F. W. Went, Ph.D., Professor of Plant Physiology, California Institute of Technology and K. V. Thimann, Ph.D., Assistant Professor of Plant Physiology, Harvard University. (London W. C. 2: MacMillan & Co., Ltd.) Price 17*s*. net.

Perspectives in Biochemistry, edited by Joseph Needham and David E. Green. (Cambridge University Press). Price 15*s*. net.

Recent Advances in Entomology. By A. D. Imms, D.Sc., F.R.S., Reader in Entomology, University of Cambridge. (London W. 1 : J. & A. Churchill, Ltd., 104, Gloucester Place). Price 15*s*.

Vaccine and Serum Therapy By A Fleming, M B, F R C S, and G F Petrie, M D, Ch B (London, W 1 J & A Churchill, Ltd, 104, Gloucester Place) Price 15s

Disorders of the Blood (Second edition) By L E H Whitby, C V O, M D, F R C P, and C J C Britton M D, N Z (London, W 1 J & A Churchill, Ltd, 104, Gloucester Place) Price 21s

Muir Bacteriological Atlas Enlarged and rewritten by C E Van Rooyen, M D (Calcutta Messrs Butterworth & Co (India), Ltd, Avenue House, Chowringhee Square, P B No 251, 1937) Price Rs 10 net

Animals and Men By David Katz (London, E C 4 Longmans, Green and Co, Ltd, 39, Paternoster Row) Price 2s 6d net

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

British India

Notification No. F. 408-36-A, dated the 18th March 1938, issued by the Government of India in the Department of Education, Health and Lands.

In exercise of the powers conferred by sub-section (1) of section 3 of the Destructive Insects and Pests Act, 1914 (II of 1914), the Central Government is pleased to direct that the following further amendment shall be made in the Order published with the notification of the Government of India in the Department of Education, Health and Lands, No. F. 320/35-A, dated the 20th July 1936, namely :—

In clause (*a*) of rule 11 of the said Order, for the words " otherwise than by sea " the words " or otherwise than by sea " shall be substituted.

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Plant Quarantine Regulations and Import Restrictions relating to the following countries have been received in the Imperial Council of Agricultural Research. Those interested are advised to apply to the Secretary, Imperial Council of Agricultural Research, for full particulars.

United States of America

1. Modification of Pink Bollworm Quarantine Regulations.
2. Mexican Fruitfly Quarantine.
3. Black Stem Rust Quarantine.
4. Modification of Dutch Elms Quarantine Regulations.
5. Service and Regulatory Announcements, July-September 1937.
6. Modification of Cotton Regulations.

Uganda Protectorate

7. Plant Protection Ordinance (1937).

Yugoslavia

8 Plant Quarantine Regulations

Summaries issued of Plant Quarantine Import Restrictions by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine of:—

9 The Kingdom of Iraq

10 The Presidency of St Christopher and Nevis, Branch West Indies.

11 The Australian Territory of Papua

12 Iran (Persia)

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

THE names of the following recipients of His Majesty the King Emperor's Birth-day Honours will be of interest to the Agricultural and Veterinary Departments in India :—

O. B. E.: DR. NAZIR AHMAD, Ph.D. (Cantab.), F. Inst. P., Director Technological Laboratory, Matunga, Bombay.

M. B. E.: HIRA LALL DUTTA, Provincial Agricultural Service, Deputy Director of Agriculture, Orissa.

M. B. E.: Mr. M. R. KRISHNASWAMI AYYAR RAMAYYA, Paddy Specialist at the Agricultural College and Research Institute, Coimbatore, Madras.

Rao Bahadur: RAO SAHIB BHASKAR PARASHRAM VAGHOLKAR, L. Ag., Principal Agricultural Officer, Sugarcane Research Scheme, Padegaon, Poona District, Bombay.

Rao Sahib: CHAUDHRI RAM DHAN SINGH, Punjab Agricultural Service, Cerealist, Lyallpur, Punjab.

Imperial Council of Agricultural Research

COLONEL SIR ARTHUR OLVER, C.B., C.M.G., F.R.C.V.S., F.N.I., Animal Husbandry Expert, Imperial Council of Agricultural Research, has been granted leave on average pay for eight months combined with leave on half average pay for two days, with effect from the 7th May, 1938 or subsequent date, preparatory to retirement.

MR. F. WARE, C.I.E., F.R.C.V.S., I.V.S., Director, Imperial Veterinary Research Institute, Mukteswar, has been appointed to officiate as Animal Husbandry Expert, Imperial Council of Agricultural Research, with effect from the date of assuming charge and until further orders.

DR. W. BURNS, D.Sc., I.A.S., Officiating Agricultural Expert, Imperial Council of Agricultural Research, has been granted leave on average pay for two months and twenty-seven days combined with leave on half average pay for seventeen days with effect from the 3rd June 1938.

MR H R STEWART, I A S, Director of Agriculture, Punjab, has been appointed to officiate as Agricultural Expert, Imperial Council of Agricultural Research, with effect from the 3rd June 1938, vice DR W BURNS, granted leave

MR SUBIMAL DUTT, I C S has been appointed Under Secretary to the Government of India in the Imperial Council of Agricultural Research Department, with effect from the 8th March 1938 until further orders

MR A McD LIVINGSTONE, M C, M.A, B Sc, Agricultural Marketing Adviser to the Government of India, has been granted leave on average pay for three months and fifteen days with effect from the 3rd June 1938, with permission to suffix Sunday the 18th September 1938

MR D R SETHI M.A, B Sc (Edin) I.A S, Director of Agriculture, Bihar, has been appointed to officiate as Agricultural Marketing Adviser to the Government of India, with effect from the 3rd June 1938, vice MR A McD LIVINGSTONE, granted leave

MR A WILSON M A B Sc, I.A.S, Special Officer, Cinchona Enquiry, Imperial Council of Agricultural Research, has been granted leave on average pay for eighteen days from the 3rd January 1938 and on half average pay for one month and four days in continuation thereof

MR TRIYUGI PRASAD M.A, LL B, Assistant Marketing Officer (Central Service, Class II), has been appointed Marketing Officer for Sugar (Temporary) with effect from the 1st December 1937

Indian Central Cotton Committee

The Governor General in Council has been pleased to reappoint DIWAN BAHADUR SIR T VIJAYARAGHAVACHARYA, K B E to be a member of the Indian Central Cotton Committee

The Governor-General in Council has been pleased to reappoint LALA SHRI RAM as an additional member of the Indian Central Cotton Committee, to represent the Cotton Mill Owners of Delhi.

MR. A. P. DARLOW, of Messrs. Gill and Company, Ballard Estate, Bombay, has been nominated by the Karachi Chamber of Commerce to be a member of the Indian Central Cotton Committee, Bombay, *vice* MR. G. C. R. COLERIDGE, resigned.

In consequence of vacancies caused by the retirement of nominated members from the 1st April 1938, the following have been nominated to be members of the Indian Central Cotton Committee, Bombay:—

By the Bombay Chamber of Commerce

1. MR. M. S. DURUTTI.

By the Tuticorin Chamber of Commerce

2. MR. J. VONESH.

By the Central Government

3. MR. H. SITARAMAN REDDI GARU, M.L.A., Vakil, Bellary, to represent the Cotton Growing Industry in the Madras Presidency.

By the Upper India Chamber of Commerce

4. MR. J. TINKER.

Imperial Agricultural Research Institute

RAO BAHADUR T. S. VENKATRAMAN, C.I.E., B.A., I.A.S., Sugarcane Expert, Coimbatore, has been granted leave on average pay for one month and fifteen days from the 20th April 1938.

MR. N. L. DUTT, M.Sc., Second Cane-breeding Officer, Coimbatore, has been appointed to officiate as Sugarcane Expert in addition to his own duties, during the absence on leave of RAO BAHADUR VENKATRAMAN.

Imperial Veterinary Research Institute

The services of Mr W Taylor D V H, M R C V S, I V S, have been replaced at the disposal of the Government of the Punjab with effect from the afternoon of the 12th March 1938

Mr Riazul Hassan B A, M R C V S I M, Officer in charge, Biological Products Section Imperial Veterinary Research Institute Izatnagar, was appointed to hold charge of the post of Director Imperial Veterinary Research Institute, in addition to his own duties with effect from the 12th March 1938, until the return of Mr F. Ware

On return from leave Mr J F Shirlaw M R C V S, was appointed temporary Veterinary Research Officer in charge of Serology with effect from the 1st March 1938, until Mr J R Haddow's return

The services of Dr Purnendu Sen M Sc Ph D, Officiating Entomologist, Imperial Veterinary Research Institute Mukteswar, have been replaced at the disposal of the Government of Bengal, with effect from the 26th March 1938

Imperial Dairy Institute

Mr S Cox Superintendent, Imperial Dairy Institute, Bangalore has been granted leave on average pay for eight months out of India, with effect from the 20th April 1938

Mr M C Rangaswamy, I D D, N D D (Scot), Supervisor in charge, Wellington Milk Depot has been appointed to officiate as Superintendent, Imperial Dairy Institute Bangalore with effect from the 20th April 1938, *vice* Mr Cox, granted leave

Madras

The Government accept the resignation tendered by Mr N G Charley, B E of the post of Research Engineer, Coimbatore, with effect from the 28th April 1938

MR. SAADAT-UL-LAH KHAN, M.A. (Oxon.), Bar.-at-Law, I.A.S., Deputy Director of Agriculture, IV Circle, St. Thomas' Mount, has been granted leave on average pay for one month and twelve days from 1st March 1938.

MR. K. RAGHAVA ACHARYA, Assistant Director of Agriculture, Cuddalore, has been appointed to be in full additional charge of the duties of the Deputy Director of Agriculture, IV Circle, during the absence on leave of MR. SAADAT-ULLAH KHAN.

MR. PAUL D. KARUNAKAR, B.Sc. (Iowa), M.Sc. (New Jersey), Agricultural Bacteriologist, has been granted an extension of leave for three months, with effect from the 1st March 1938.

MR. M. SANYASI RAJU GARU, Assistant in Bacteriology, has been appointed as Officiating Agricultural Bacteriologist, Coimbatore, from date of taking charge, *vice* MR. PAUL D. KARUNAKAR, applied for extension of leave.

Bengal

MR. A. D. MACGREGOR, F.R.C.V.S., F.Z.S., Principal, Bengal Veterinary College, has been appointed to be Veterinary Adviser to the Government of Bengal, in addition to his own duties, during the absence on leave of MR. P. J. KERR, or until further orders.

RAI SAHIB MOKSHADA PROSAD GHOSH, G.B.V.C., Assistant Director, Civil Veterinary Department, Eastern Range, has been appointed to officiate as Director, Civil Veterinary Department, Bengal, in the Bengal Higher Veterinary Service, during the absence, on leave, of Mr. P. J. KERR, or until further orders.

MR. HEM CHANDRA DAS GUPTA, Inspector, Civil Veterinary Department, has been appointed to act as Assistant Director, Civil Veterinary Department, Eastern Range, *vice* RAI SAHIB MOKSHADA PROSAD GHOSH, appointed to act as Director, Civil Veterinary Department, Bengal.

MR W M CLARK, M B E , B Sc I A S , Deputy Director of Agriculture, Burma has been appointed to act as Deputy Director of Agriculture, Eastern Circle Bengal with effect from the 10th February 1938 *vice* MR P C CHAUDHURY, appointed to act as Assistant Director of Agriculture

RAI SAHIB NRIPENDRA NATH MAZUMDAR, G B V C , Assistant Director, Civil Veterinary Department Western Range, has been granted leave for the period from the 25th March 1938 to the 30th June 1938, preparatory to retirement

MR BHUPENDRA NATH DAS GUPTA, Inspector, Civil Veterinary Department, has been appointed to act as Assistant Director, Civil Veterinary Department, Western Range, during the absence, on leave, of RAI SAHIB NRIPENDRA NATH MAZUMDAR, or until further orders

RAI SAHIB CHUNILAL MUSTAFI, Chief Superintendent, Dacca Farm, has been appointed to act as Deputy Director of Agriculture, Western Circle, with effect from 1st May 1938, *vice* MR J N SIRKAR, deceased

MR GOSHTHA BIHARI PAL, M Sc , Agricultural Chemist, Bengal, has been granted leave on average pay for two months, with effect from the 3rd May 1938

United Provinces

MR C H PARR I A S , Deputy Director of Agriculture, Bundelkhand Circle, Jhansi, has been granted leave on average pay for a period of five months and on half average pay for one month, with effect from the 1st April 1938, or subsequent date of relief

MR T R LOW, I A S , on foreign service as Director, Institute of Plant Industry, Indore, has been granted leave out of India, on full average pay for three months combined with leave on half average pay for four months and five days, with effect from the 25th March 1938, or date of relief

MR. MAQSUD ULLAH S. JUNG, Dip. Agri., Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly, has been transferred to Bundelkhand Circle, Jhansi, in the same capacity.

MR. S. C. ROY, M.Sc., Assistant Director of Agriculture, at present working as Cane Development Officer, Eastern Range, Gorakhpur, has been appointed to officiate as Deputy Director of Agriculture, *vice* Mr. C. H. PARR, I.A.S., granted leave, but to hold charge of the Rohilkhand and Kumaun Circle.

Punjab

MR. W. TAYLOR, M.R.C.V.S., D.V.H., I.V.S., on reversion from the post of Director, Imperial Veterinary Research Institute, Mukteswar, has resumed charge of his appointment as Principal and Professor of Medicine, Punjab Veterinary College, Lahore, with effect from the 14th March 1938, relieving CAPTAIN U. W. F. WALKER, M.C., M.R.C.V.S., I.V.S., of the additional charge of Principal and MR. SETH MOHAMMAD SARWAR, M.R.C.V.S., of the duties of the post of Professor of Medicine.

On return from leave MR. DARSHAN SINGH, Bar.-at-Law, M.R.A.C., F.R.H.S., M.R.A.S., I.A.S., resumed charge of his appointment as Deputy Director of Agriculture, Gurdaspur, with effect from the 3rd February 1938, relieving MR. H. G SADIK, who reverted to the post of Extra Assistant Director of Agriculture.

KHAN BAHADUR M. FATEH-UD-DIN, M.B.E., I.A.S., Deputy Director of Agriculture, Jullundur, has been transferred temporarily to foreign service out of India as Agricultural Expert Adviser to the Government of Bahrain, from the 21st February 1938.

MR. H. G. SADIK, B.A. (Oxon.), Extra Assistant Director of Agriculture, Jullundur, has been appointed Officiating Deputy Director of Agriculture, Jullundur, with effect from the 21st February 1938, *vice* KHAN BAHADUR M. FATEH-UD-DIN, M.B.E., I.A.S., transferred temporarily to foreign service under the Bahrain Government.

KHAN SAHIB AGHA YUSAF ALI KHAN, Deputy Director of Agriculture, Montgomery, has been granted leave on average pay for four months, with effect from the 4th March 1938

MALIK SULTAN ALI, I.A S, Deputy Director of Agriculture, has been transferred to Montgomery, with effect from the 4th March 1938, relieving KHAN SAHIB AGHA YUSAF ALI KHAN, granted leave

The services of DR S V DESAI, B Sc, Ph D (Lond), D I C (Lond), Agricultural Bacteriologist, Lyallpur, on probation, have been replaced at the disposal of the Government of India in the Department of Imperial Council of Agricultural Research, with effect from the 8th March 1938, and he reverted to his substantive appointment in the Imperial Agricultural Research Institute, New Delhi

Central Provinces and Berar

MR J S GAREWAL, M R C V S, I V S, Officiating Director of Veterinary Services, Central Provinces and Berar, reverts to the Government of the Punjab, with effect from the date on which he makes over charge of his duties

MR J C McDOUGALL M.A, B Sc (Edin), Director of Agriculture, Central Provinces and Berar, has been appointed to hold charge of the office of the Director of Veterinary Services, Central Provinces and Berar, in addition to his own duties, vice Mr J S GAREWAL, reverting to the Punjab, or until further orders

MR R H HILL, M A. (Cantab), Deputy Director of Agriculture, Economics and Marketing, Central Provinces and Berar, has been granted leave on average pay for six months and leave on half average pay for two months, with effect from the 17th March 1938, or such subsequent date on which he takes it

MR P D NAIR, M A, L Ag (Hons), Post graduate (Pusa), Assistant Director of Agriculture, attached to the office of Director of Agriculture Central Provinces and Berar, has been appointed to officiate as Deputy Director of Agriculture Economics and Marketing, *vice* MR R H HILL, proceeding on leave or until further orders

Mr. P. S. Nair, G.B.V.C., Assistant Director of Veterinary Services, Nagpur Division, has been granted leave on average pay for two months, with effect from the date on which he avails himself of it.

Mr. S. S. Ayer, G.B.V.C., Senior Veterinary Inspector, Gondia, has been appointed to Officiate as Assistant Director of Veterinary Services, Nagpur Division, *vice* Mr. P. S. Nair, granted leave or until further orders.

Mr. J. F. Dastur, M.Sc., D.I.C., Mycologist to Government, Central Provinces and Berar, has been granted leave on average pay for two months and six days, with effect from the 25th April 1938.

Bihar

Major P. B. Riley, M.R.C.V.S., I.V.S., Director, Veterinary Services, Bihar, has been granted leave on average pay for five months and twenty days and leave on half average pay for one year, eight months and ten days, with effect from the 1st April 1938, preparatory to retirement.

Mr. Muhammad Ismail Malik, M.R.C.V.S., Officiating Principal of the Bihar Veterinary College, Patna, has been appointed to act as the Director, Veterinary Services, Bihar, with effect from the 1st April 1938, during the absence, on leave of Major P. B. Riley, I.V.S., or until further orders.

Mr. Muhammad Ismail Malik will, in addition to his own duties as Officiating Director, Veterinary Services, hold charge of the current duties of the Principal of the Bihar Veterinary College, with effect from the 1st April 1938, until further orders.

Maulvi Muhammadi Khan, Assistant Director of Agriculture, Pusa, has been granted leave on average pay for two months, with effect from the 4th April 1938 or any subsequent date from which he avails himself of it.

Dr Harendra Nath Mukherjee, Senior Scientific Assistant Chemical Section has been appointed to act as Agricultural Chemist, *vice* Dr T J Mirchandani deputed on foreign service, with effect from the afternoon of the 2nd November 1937 His headquarters will be at Sabour in the district of Bhagalpur

Orissa

Mr Nilamani Chatterji G B V C, Assistant Director of Veterinary Services, Orissa has been vested with all the powers of a Deputy Director of Veterinary Services in the districts of Ganjam (excluding the Khondmals) and Koraput, with effect from the 1st October 1937

Rai Sahib Jagannath De a retired Government servant of the Agricultural Department has been reappointed to act as Assistant Director of Agriculture Orissa with effect from the 3rd March 1938 until further orders

Mr P S Kuppuswami has been appointed temporarily as the Veterinary Investigation Officer for Orissa with effect from the date he joins the appointment

North West Frontier Province

Lieutenant Colonel E W C Noel C I E D S O, of the Indian Political Department relinquished charge of the Office of Director of Agriculture and Allied Departments North West Frontier Province, with effect from the forenoon of the 1st March 1938

Sind

The Governor of Sind has been pleased to appoint Rao Bahadur V R Phadke, G B V C, J P, late Principal of the Bombay Veterinary College, Bombay Presidency to act as Director of Veterinary Services, Sind, *vice* Mr J H G Jerrom, M R C V S, I V S, proceeding on leave for six months with effect from the 9th May 1938

BURMA

MR. A. MCLEAN, I.A.S., Deputy Director of Agriculture, East Central Circle, has been transferred to Mandalay as Principal, Agricultural College, Mandalay, in place of MR. D. RHIND, who remains as Economic Botanist with headquarters at Mandalay.

The services of MR. W. M. CLARK, M.B.E., B.Sc., I.A.S., are placed permanently at the disposal of the Government of Bengal, with effect from the 4th February 1938.

U THET SU, D.I.C., B.Ag., Mycologist, has been posted as Deputy Director of Agriculture, East Central Circle, with headquarters at Pyinmana in place of MR. A. MCLEAN, transferred.

DR. A. T. SEN, M.Sc., Ph.D., A.I.C., Agricultural Chemist, has been, on return from leave, reposted as Agricultural Chemist with headquarters at Mandalay.

Recent Publications of the Imperial Agricultural Bureaux

I OBTAINABLE FROM THE IMPERIAL BUREAU OF SOIL SCIENCE, ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, HERTS

Periodical Abstracts

	s	d
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935 . . .	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers" Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications Separate copies, each . .	0	6

Occasional Papers

Technical Communications—		
34 Tropical Soils in relation to Tropical Crops	2	6
Annual Report For the year 1933 34	0	6
,, 1934 35	0	6
,, 1935 36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J B Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34 .	25	0

II OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL HEALTH, VETERINARY RESEARCH LABORATORY, NEW HAW, WEYBRIDGE, SURREY

Abstracting Journal

The Veterinary Bulletin—		
1931 Vol 1 Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes Monthly (1st Number, January) . . .	5	0
Annual subscription (postage paid)	40	0

Indexing Publication — s. d.

Index Veterinarius.—Four issues a year. First issue, April 1933. Annual subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed 100 0

III. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL NUTRITION, ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEEN

Journal

Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—
- Subscription per volume of 4 numbers 42 0
- Per single number 13 0

Occasional Papers

Technical Communications—
6. The Composition of Certain African Foods and Feeding Stuffs . . 1 0
7. Wheat. Pre-eminence as a Cereal Food: Nutritive Value; Relation to Health and Disease. 1 0

Occasional Communications—
1. The Effect of Climate on the Composition of Pasture Plants . . ..

IV. OBTAINABLE FROM THE IMPERIAL BUREAU OF PLANT BREEDING AND GENETICS PLANT BREEDING INSTITUTE, SCHOOL OF AGRICULTURE, CAMBRIDGE

Journal

Plant Breeding Abstracts—
- Quarterly. Annual subscription 15 0
- Single copy 5 0

Occasional Papers

Indexes to Plant Breeding Abstracts—
- Subject Index to Vols. I to V of Plant Breeding Abstracts . . . 5 0
- Subject Index to Vol. VI of Plant Breeding Abstracts 2 6

Supplements to Plant Breeding Abstracts—
- Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I 0 6
- Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II 5 0

Technical Communications—
- Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics) 10 0
- The South American Potatoes and their Breeding Value 3 6

Bibliographical Monographs—
- Breeding Resistant Varieties, 1930-33 (Supplement) 2 0
- The Experimental Production of Haploids and Polyploids . . . 5 0

V. Obtainable from the Imperial Bureau of Pastures and Forage Crops, Welsh Plant Breeding Station, Agricultural Buildings, Alexandra Road, Aberystwyth, Wales

Journals

	s.	d.
Herbage Abstracts—		
Quarterly. Annual subscription	15	0
Single number	5	0

Herbage Reviews—

Subscription is at present—Vol 1 (1933), Vol 2 (1934), Vol. 3 (1935), Vol 4 (1936)—included in that to Herbage Abstracts.

Occasional Papers

Bulletins—		
18 Pastures and Forage Crops in South Africa	3	0
19 Production of Grass Seed	5	0
20 Insects and other Pests Injurious to the Production of Seed in Herbage and Forage Crops	2	6
21. The Influence of Climatic Conditions on Type Composition . .	1	0
22 Technique of Grass Seed Production at the Welsh Plant Breeding Station	5	0
23 Production of Legume Seed	5	0
24. Collection of Native Grass Seed in the Great Plains, U. S. A. .	2	0

VI. Obtainable from the Imperial Bureau of Horticulture and Plantation Crops, East Malling Research Station, East Malling, Kent

Journal

Horticultural Abstracts—

A quarterly abstract publication of current horticultural literature—		
Annual subscription	15	0
Single copy	4	0

Technical Communications

7. Vegetative Propagation of Tropical and Sub tropical Fruits, 1936. J. St. Clair Feilden and R J. Garner	2	0
8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R M. Greenslade	2	6

Occasional Papers

3. Annotated Bibliography on Bitter-Pit, 1934	1	6
4 Recent Work of Tropical and Sub tropical Interest . .	0	6

	s.	d.
Other Publications—		
Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science.* Available from the Bureau	5	0
Old and New Standpoints on Senile Degeneration, 1931. A. P. C. Bijhouwer	0	6
Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).		
Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1	0

VII. Obtainable from the Imperial Bureau of Animal Breeding and Genetics, Institute of Animal Genetics, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh

Journal

	s.	d.
Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription	15	0

Occasional Papers

	s.	d.
Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0	6
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2	0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology (Helminthology), Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St. Albans, Herts

Journal

	s.	d.
Bibliography of Helminthology. For the year 1933—		
Library Edition, bound in cloth	10	6
Stiff paper cover only	8	0
Helminthological Abstracts (1932 onwards). Issued in five or six parts per volume, each volume covering the literature of a single year. Subscription per volume, payable in advance	30	0
Completed volumes, bound in cloth	32	0

Occasional Papers

	s.	d.
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11. Recent Developments in the Control of *Heterodera marioni*	1	6

PUBLICATIONS ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY, 41 QUEEN'S GATE, LONDON S W 7

	s. d.
Bulletin of Entomological Research—	
Published quarterly, and containing original articles on Economic Entomology Issued post free.	
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Vol XXIII (1935)	42s.	21s.

	s. d.
Zoological Record—Part Insecta—	
Published annually about July in each year and containing as complete a record as possible of the literature of the previous year, chiefly from the systematic standpoint.	
Annual subscription (including postage)	15 6
Report of the Fourth Imperial Entomological Conference, 19th—27th September, 1935	4 0

PUBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGICAL INSTITUTE, KEW, SURREY

Journal

Review of Applied Mycology—	
Annual subscription, 12 monthly parts, with title page and index (post free)	21 0
Single part	2 0
Title-page and index	3 0
Report on the Third Imperial Mycological Conference, 1934 . . .	2 0

PUBLICATIONS OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, INDIA

(Prices are inclusive of packing and Indian postage)

1. Agriculture and Live-stock in India

ICAR. 1. A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics (Established 1931. Published in January, March, May, July, September and November. Prepayable subscription Rs. 6 or 9*s.* 9*d.* per annum. Price per part Rs. 2 or 3*s.* 6*d.*) Volumes I to VII complete are available.

2. The Indian Journal of Agricultural Science

ICAR. 5. A bi-monthly scientific journal of agriculture and the allied sciences, mainly devoted to the publication of the results of original research and field experiments. (Established 1931. Published in February, April, June, August, October and December. Prepayable subscription Rs. 15 or 24*s.* per annum. Price per part Rs. 3 or 5*s.* 3*d.*) Volumes I to VII complete are available.

3. The Indian Journal of Veterinary Science and Animal Husbandry

ICAR. 6. A quarterly journal for the publication of scientific matter relating to the health, nutrition and breeding of live-stock. (Established 1931. Published in March, June, September and December. Prepayable subscription Rs. 6 or 9*s.* 9*d.* Price per part Rs. 2 or 3*s.* 6*d.*) Volumes I to VII complete are available.

4. Scientific Monographs of the Imperial Council of Agricultural Research

ICAR. 10·1. No. 1. The Fungi of India. By E. J. Butler, C.I.E., D.Sc., M.B., F.R.S. and G. R. Bisby, Ph.D. (1931). Price Rs. 6-12-0 or 11*s.*

ICAR. 10·2. No. 2. Life-histories of Indian Microlepidoptera, Second Series : Alucitidae (Peterophoridæ, Tortricina and Gelechiadæ). By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1932). Price Rs. 3-4-0 or 5*s.* 6*d.*

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ICAR. 10·4. No. 4. Life-histories of Indian Microlepidoptera : Cosompterygidæ to Neopseustidae. By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1933). Price Rs. 4-8-0 or 7*s.* 6*d.*

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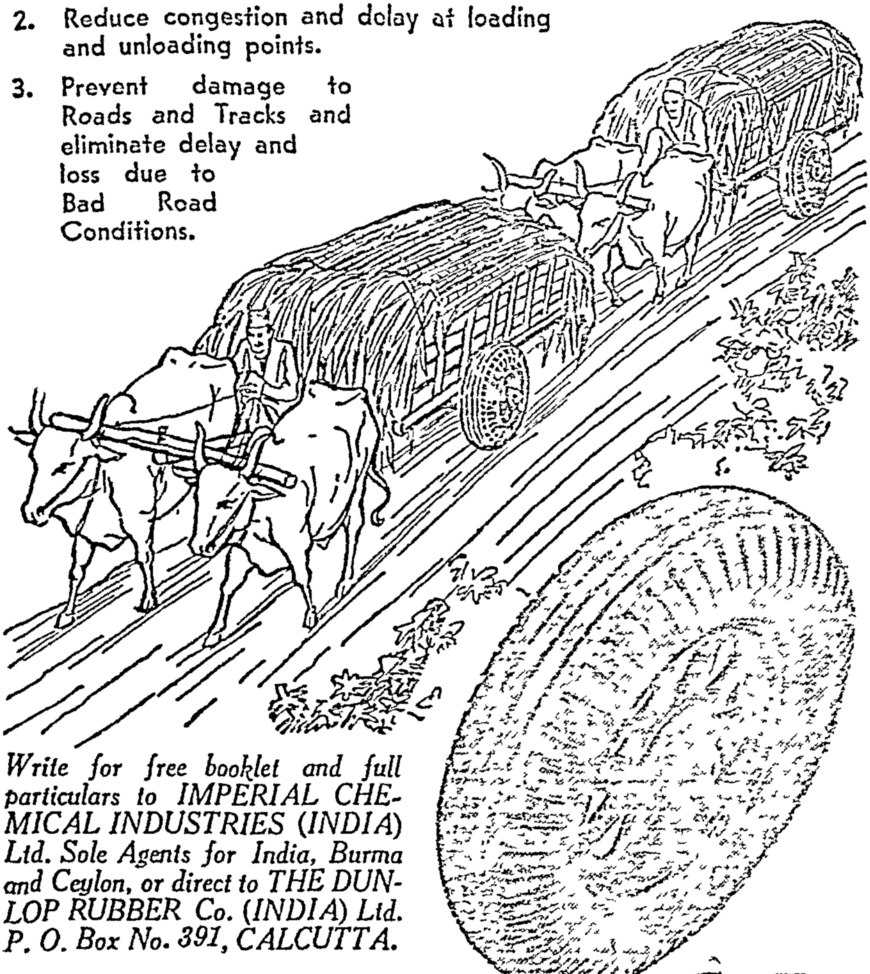

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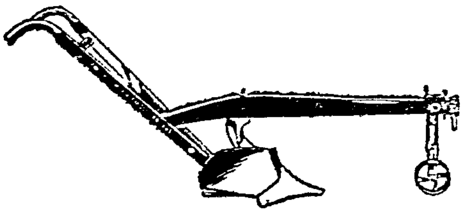

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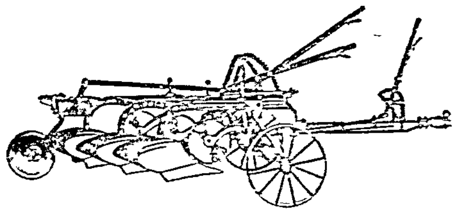

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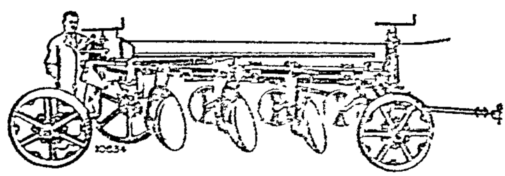

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(Vol. VIII, Part V)

September, 1938

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Agriculture & Live-stock in India

Vol. VIII, Part V, September 1938

EDITORIAL

MODERN TRENDS IN VETERINARY EDUCATION

In another part of this number will be found a somewhat detailed description of a recent visit to some of the German Veterinary Colleges and this seems, therefore, to be a suitable opportunity to examine the present trend of veterinary education, so that those concerned with this subject in India may be in a position to apply the latest developments to the best advantage of this country.

The outstanding feature of the German colleges is the comprehensive character of the course, which provides the student with a thorough training in all branches of animal health. The different subjects are grouped together in appropriate Institutes or Sections, each under a separate head and each self-contained in the matter of lecture rooms, practical class-rooms, museum, library, and those appendages which are needed for teaching the practical side of the subject concerned, such as an aquarium, a herd of dairy animals, sick wards, etc.

The question whether veterinary colleges are successfully fulfilling their duties or whether, in order to meet present-day requirements, a reorientation of their curriculum is necessary has recently been the subject of enquiry in other countries. Speaking generally, the present demand is for a graduate versed not so much in the science of curative medicine and

surgery but in preventive medicine, using the term in its widest sense The veterinary graduate of the future therefore, should be a man brought up amongst animals in health with the knowledge of how to maintain them in the fullest health and not merely one to be called in when an animal has fallen sick In this connection it is of interest to read the following extract from an article which appeared a few months ago in the English weekly paper ' The Field ", which has always been a staunch advocate of rural development —

> ' Modern veterinary practice approaches the incidence of disease from a new angle Rather than prepare to cure the afflicted, it endeavours to build up a resistance within the animal to safeguard it against disease It is the study of the animal in health as opposed to ill health which yields the greatest information "

To attain this end, it is necessary to provide veterinary students of all classes with the means of obtaining daily contact with animals in health, as can be done by attaching a live stock farm or a herd of dairy cattle to each veterinary college and also to pay more attention in the curricula to the subjects of Genetics and Nutrition, and their application to animal health If necessary, this must be done at the expense of such subjects as Anatomy and Surgery for if the present day ' cow shed clinician is to be replaced by a more complete animal husbandman the idea of training a man merely in the science and art of veterinary medicine and surgery, which is the acknowledged aim of most veterinary colleges to day will require revision and courses will have to be designed to provide a student with a sound knowledge of the three major subjects of medicine animal nutrition and animal breeding which are the basis of all live stock improvement work Moreover, a deeper study of animal Physiology and its allied subjects should tend to widen the outlook of the veterinary student and develop his imagination

The importance of a general knowledge of a clinical subject like surgery must not be overlooked but to obtain more than ordinary competence in this and other clinical subjects a student might be expected to take post graduate instruction as he would if he wished to specialize in any of the laboratory subjects and it is of course most important to frame the curriculum in such a way that specialisation in any subject immediately after graduation is rendered easy

In this connection attention may be drawn to the desirability of encouraging veterinary graduates to specialize in subjects other than Pathology and Bacteriology A vast field awaits investigation on the veterinary side of such subjects as Protozoology, Helminthology, Entomology and Biochemistry, and also in Animal Physiology, Animal Nutrition and Animal Genetics, and while we must express gratitude for the help received in these subjects in the past from pure scientists and others, there can be no doubt that, given equal intellectual equipment, a veterinarian working in one of these branches of science should produce the more practical results

This raises the question of what can be done to improve the flow of suitable recruits to the research side of the profession. In England this same question has recently been under consideration and as a result a course has been designed in which the student will spend his first three years at Cambridge University taking the Natural Science Tripos and the two final years at the Royal Veterinary College, London. In this way the two most important factors in the training of a veterinary scientist, *viz.*, the highest type of basic scientific education and a suitable animal environment, have been blended in an admirable manner.

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SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X THE UNITED PROVINCES CULTIVATOR

5 THE TURK CULTIVATOR OF ROHILKHAND

BY

MUNSHI TASAWWAR HUSAIN NAQVI, Dip Agri

Divisional Superintendent of Agriculture, Rohilkhand and Kumaun Circle, Moradabad

Rohilkhand is a part of the United Provinces of Agra and Oudh comprising the districts of Moradabad, Bijnor, Budaun Pilibhit Shahjahanpur, Bareilly and the state of Rampur Literally speaking, Rohilkhand means the abode of the mountaineers The name is derived from the Rohilla, a tribe of Afghan highlanders who conquered this region towards the beginning of the eighteenth century It covers an area of about 11 000 sq miles and has a population of 5 481,577

The Turk who represents a typical cultivator of this area is, however, a much older resident of Hindustan His origin dates back from the invasion of Mohamed Ghori in the year 1192 A D Under the command of Salar Masud Gazi one of Mohamed s generals the Turks overran a greater part of the United Provinces till their progress was checked by the general s death in Bahraich

Though the Turk has settled down to a peaceful life of cultivation and hard toil he has not forgotten the martial traditions of his race and the fierceness of his name and history are in no way belied The intervening centuries have left no mark upon the soldier who came to India more than 700 years ago but at the same time they have produced an exceptionally good type of farmer who plies his spade and plough with as much zeal and vigour as his ancestors wielded their swords Efficiency self reliance, diligence and a religious outlook almost amounting to fanaticism are characteristic of these Turk cultivators The Turk's hospitality is proverbial and no one can return from his door without partaking of


A typical Turk enjoying his *hukka*

sharbat in summer and milk in winter. A *hukka* smoke is, of course, always offered. The Turk cultivator is also very kind to his animals.

As a cultivator, the Turk has acquired practical skill of a very high order which is embodied in his *reets* or proverbs. Put to the test of scientific knowledge, the *reets* are very instructive and accurate. It will not be out of place to quote a few of them here.

" *Cheede cheede till bhale aur cheedi bhali kapas*
Jeski cheedi eekh rahe uski nahin jineki aas ".

i.e. " *Til* and cotton should be thinly sown but a man with a thin crop of cane should not hope to live ."

" *Ghanna gehun boey ek bai aur eekh boey teh bai*
Larki ho tari khari Assar boey bari."

i.e. " If you have a virgin daughter to marry and want money, sow your wheat thickly behind the plough, your sugarcane with three ploughs and your cotton in *Assar* with the rains. "

" *Dhan ghanna ban beghara, mendak phudki jowar.*
pehre pehre bajra to ghore ghoomen dewar ".

i.e. " If you wish to be rich and have horses at your doors, sow your paddy thick, your cotton thin, your *jowar* at a frog's leap and your *bajra* a step apart."

There is a large number of such proverbs ; in fact, for every agricultural operation some proverb or other comes handy to guide his conduct in the fields.

Suspicious of any outside interference, the Turk villages are closely knit together into a *bradry* (brotherhood) whose affairs are controlled by panchayats with annually elected *sardars* (presidents) at their heads. Usually a learned old man is chosen for the purpose. As the word signifies, the *sardar* is the greatest man in the *bradry.*

The panchayat controls all the activities of the community both internal and in relation with the outside world. Decisions on important matters are taken only after consulting the whole *bradry*, and once taken are binding on every member. Any flouting of this general will by an individual, any disregard of the established custom, or some moral turpitude, is seriously dealt with by the panchayat. The delinquent is severely ostracized which in their parlance is *hukka pani band karna.* This means that the man thus punished is not respectable enough to smoke the same *hukka* or drink from the same bowl as the honourable *bradry.* If the offender repents and expresses a desire to retrieve his guilt, he must atone for it by means of a grand feast to the whole community. The choice of the dishes rests with the latter. This is an excellent check on those who are mischievously inclined and tends to encourage good conduct and orderly behaviour. The panchayat

raises a small subscription from the members to meet those expenses that are collectively incurred by the whole *bradry*

Marriage, the most important event of a man's life, is settled among the Turks as amongst most other communities in this country, by the parents of the couple It consists of two parts—the *nikah*, a religious ceremony, and the *rukhsat*, the actual taking away of the bride The *nikah* is often performed at an early age when the bride and bridegroom are ten or twelve years old It is a strictly religious ceremony two *maulvis* acting as agents one for the boy and the other for the girl After reciting verses from the Holy Quran the contract is sealed and entries made in the *maulvis'* books *Sharbat* and dried dates are then distributed to the company and for all theoretical purposes as also before the law they are husband and wife thenceforth But the actual consummation takes place after the *rukhsat* which is usually done at a more mature age *Rukhsat* is the time for celebrations and feasting The bridegroom and his party visit the bride's place and are entertained by her parents to a feast of *bhat* (boiled rice) and *urdgosht* (meat and pulse curry) Having enjoyed themselves for two or three days at the bride's expense the bridegroom and the party, which consists exclusively of men return home with the bride The couple departs in a *rath*, a decorated bullock chariot while the others ride home in *rabbas* or light two-wheeled bullock carts On reaching home, the bridegroom also celebrates the occasion by feasting the whole *bradry* if he can afford to do so or at least by entertaining his friends and near relatives The month of May is the marriage season as by that time both the sugarcane and *rabi* crops have been harvested and there is some money to spend

In a Turk family duties are strictly apportioned between the males and the females Men are responsible only for cultivation and other outdoor work, while the women folk manage the household take care of the cattle grind the corn milk the animals make ghee and sew and spin Of the income, the portion derived from the sale of dung cakes is the woman's exclusive share, which she usually spends in buying ornaments A Turk wife is extremely obedient and faithful

A Turk village is divided into *abadi* and the *bar* The *abadi* or populated portion is situated on a higher level from the *bar* which is the surrounding cultivated area Every village invariably possesses a mosque where men devoutly inclined, offer their prayers A *mulla* is usually in charge of the mosque and is maintained by the community In addition to officiating at prayer time it is also a part of the *mulla's* duty to teach reading the Holy Quran to the village boys The girls are generally not initiated into the art as reading and writing are not considered good for the fair sex

The houses are usually of mud and thatch and consist of a living room, a kitchen a *saar* or cattle shed and a courtyard the whole being surrounded with a wall, as the women observe *purdah* The well to do Turk also keeps a *choupal* outside

the purdah wall. *Choupals* are the meeting places of the men where they smoke and chat in the evenings. The size of the house and the presence of the *choupal* denote the prosperity of the family. All Turk houses are scrupulously clean, being plastered with mud and white-washed with *pindol* or whiteclay twice a year *i.e.*, before and after the rains.

The clothing requirements of a Turk are few. During working hours he puts on a *dhoti*, a *bundi* and a cap, while on festive occasions or when visiting another village he uses a *pajama*, a shirt, a *mundasa* or turban and a shoulder cloth (which is the equivalent of a gigantic handkerchief), and also indulges in the rare luxury of a pair of shoes. In winter a *chaddar* (thick *khadder* cloth) or a *mirzai* (a jacket stuffed with cotton) is worn during the day, while at night a *razai* (cotton-stuffed quilt) serves the purpose of both mattress and cover. The universal dress among the females is a *pajama*, a *kurti* or shirt, and a *dupatta* or head cover which also serves as a veil when they go out. Ornaments are of course indispensable and generally silver ones are used.

The daily food of a Turk consists of *roties* (unleavened bread), *dal*, *gur*, *matha* (skim milk) and *sag* or weeds picked up from the fields. Rice, meat and vegetable are occasional luxuries. Three meals are taken during the day, beginning with the breakfast at about 9 A.M. which is partaken of in the fields. The second or midday meal is taken at about 1 P.M. on returning home from work and the third at sunset. Guavas, melons and mangoes are the only fruits which he can afford.

Ghee-production and *khandsars* or indigenous sugar manufacture are the only two subsidiary paying industries. Although rearing of cattle, specially of buffaloes, is very common, it is considered below the dignity of a Turk to sell milk. He can only deal in ghee and must use the skim milk at home. A similar prejudice exists against hiring out bullocks or carts. *Khandsars* are owned only by the well-to-do Turks but this is a far-famed industry of Rohilkhand and there is no doubt that some of them are past masters in the art of *rab*-making. The industry has been famous for centuries and a story is told how the Great Akbar once tasted the sugar produced by the Turks and thenceforward always obtained his supplies of the article from them. Basket-making is also practised, but not on an extensive scale and is not very remunerative.

The only occasions when a Turk gets an opportunity for a little merry-making are the festivals of *Id* and *Charyan*. Both of them are, however, essentially religious in character. *Id* is the thanksgiving festival for the successful termination of *Ramzan*, the month of fasting among Musalmans. After the thanksgiving prayers, gaily dressed parties visit each other and are entertained to *siwanyan* (macaroni) and milk, while every one embraces every one else. *Charyan* is the name given to a *mela* held to commemorate the aniversary of Salar Masud Ghazi's invasion.

The occasion is celebrated in every village in which the Ghazi camped on his way to Bahraich *Dungles* (wrestling) and fencing matches are held on this day and other feats of strength shown The winners are garlanded, taken out in procession and feasted Bullock racing is also a favourite amusement on this occasion and attracts large crowds The religious side is, however, never forgotten Alms are freely distributed and the poor fed by every one according to his means

The economics of a Turk village is based on barter At harvest, every Turk cultivator pays the village carpenter, the blacksmith the sweeper and the barber a certain portion of his produce for their services during the past six months

FIG. 1. A Teli Cultivator
(Central Provinces)

FIG. 2. A Satnami Cultivator
(Central Provinces)

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XIII. THE CENTRAL PROVINCES CULTIVATOR

I. THE CHHATTISGARH CULTIVATOR

BY

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SEVERAL types of soil are to be found in the typical Chhattisgarh village, ranging from *bhata* (red gravelly soil) at the highest levels to heavy black soil in the low-lying portions. Intermediate types lie between these two extremes. Though a variety of crops could be grown under these conditions, paddy is the most favoured crop and occupies the biggest area. In some tracts where heavy soils abound, both *rabi* and *kharif* crops are grown.

There are two main cultivating castes, the Telis and Satnamis. Both are simple and straightforward in character, but the latter is inclined to go to extremes when his feelings are roused by village factions. The chief articles of clothing are a *patka* (loin cloth) and a *paga* (small turban). A country woollen blanket, a bamboo hat, a pair of sandals and a big bamboo stick complete his turnout for all seasons. He is of medium stature, brown complexion and fairly good physique.

His main meal consists of cooked rice served with either a pulse or seasonal vegetables, whichever be available. It is eaten in the evening after a hard day's work. A little rice is left over from the evening meal for the next day. This is put to soak in water and the result is *basi* which forms his next meal, taken at midday after his bath. On festive occasions he is very happy if his ordinary fare is supplemented with fish and *bhajias* (sweetened wheat or rice flour paste, fried in oil or ghee in small lumps). He cannot, however, forget his *chongi* (pipe) of which he is very fond ; he will have it at any cost.

In the *basti* there is much overcrowding of houses. Of roads in the proper sense there are none, only narrow tortuous lanes. The houses have mud walls and tiled roofs. It is customary to have small separate buildings to serve as kitchen guest room, sleeping accommodation, and cattle shed. Windows have no place in their houses. The only articles of furniture are a few cots made of bamboo and rope. The utensils include brass dishes and *lotas* and mud pots for

cooking Mud or bamboo bins are constructed in each house to store the produce of the fields

Social customs —Socially there is great unity between persons belonging to the same caste Each caste has its own *panchas* who act as head of the caste and their decision is final in every caste quarrel For breaking caste rules, persons are out casted If any person of the lower caste beats a person of the upper caste the latter is outcasted Inter dining is also prohibited and outcasting is the punishment inflicted in this respect as well The *panchas* assemble frame charges against the accused who if proved guilty, has to pay a fine before he can be re admitted This fine is generally utilized to provide a feast for the caste people who collect in great numbers on such occasions

Betrothal is the first step in marriage negotiations, at times this takes place when the child is still in the womb Child marriage is the general rule but the girl is never sent to the husband's house till she attains the age of puberty It is incumbent on the parties to invite all caste people to the ceremony and as a general rule most of the people attend Two or three dinners from the bride's side and one from the bridegroom's complete the ceremony It is customary for the near relations to contribute something in kind to help the fathers of the bride and bridegroom

The Chhattisgarhi cultivator puts in just enough work to maintain himself and his family in a very humble way In tracts where paddy is the only crop his field work starts with manuring the fields in May followed by sowing operations which commence with the break of the monsoon and last for a month July and August are months of hard labour in the field for *biasi* and weeding operations Once the paddy is in ear and wild rice (*karga*) is eliminated he gets some leisure He finishes his harvesting and threshing by the end of December and has ample time at his disposal thereafter The more needy supplement their earnings by undertaking carting work or other outside labour when there is nothing to do in the fields In tracts where irrigation facilities are available the cultivators are taking to planting sugarcane and thereby increase their income Where *rabi* crops are grown as well as *kharif* the cultivator is kept fully engaged Scattered holdings are a great handicap in this tract but the benefits of the consolidation now in progress are fully realized The Chhattisgarhi cultivator is an expert in laying out catch water drains in right contours to take the water from higher areas to his fields

The main causes that have contributed to his poor financial position are neglect of manure and cattle He burns two thirds of the dung produced and one-third is preserved for manure It is only of late that he has taken to better preservation of manure He believes in keeping a large number of cattle beyond his means to feed properly with the result that their condition is wretchedly poor and he sustains great loss from deaths This takes him to the door of the money lender and once in the grip of the latter, he is very much handicapped and enterprise ceases

The tiller of the soil is very fond of attending weekly bazars, where both sexes flock in great numbers. He will also observe the numerous festivals no matter how urgently field operations may claim his attention. He seems to forget his worries, for the time being and enjoys these outings thoroughly. After all he is proverbially a contented man. This contentment is, however, not natural but has been brought about by the conditions under which he has been living. Every attempt on his part to improve his lot having proved a failure, he has begun to believe that he was destined to lead the sort of life he is leading and this has tended to kill all initiative in him. For this he himself is mainly responsible, though he does not realize it. He permits a number of leakages in his income of which the most important are expenses beyond his means for marriages or after a death in the family, wrong notions of charity which enable swindlers to deprive him of a good share of his produce at the time of threshing, advance credit purchases of clothing and utensils before harvest time at enhanced prices from itinerant dealers, and absence of any organization to save him from the loss sustained in the purchase of his requirements or in the sale of his produce. His case can be likened to that of a man trying to replenish a water pot with a number of holes in the bottom. The more he pours in, the greater the flow from the holes because of the extra pressure. It is, therefore, as necessary to stop the leakages in his income as it is to increase his resources. It is very difficult to convince him of the merits of any improvement but once convinced, he takes it up in right earnest and follows it with zeal. There are encouraging signs that he has begun to realize the importance of good seed, improved tillage and adequate manuring and that he is awakening to the possibility of utilizing these improvements for his own benefit and not that of the money-lender. He is also beginning to see some meaning in the suggestions for co-operative action which are being patiently instilled into him by the various departments.

THE SYSTEMATIC IMPROVEMENT OF LIVE STOCK IN INDIA

BY

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As I am shortly vacating my appointment of Animal Husbandry Expert, I feel that I ought to place on record for the information of those who have not had the same opportunities, the conclusions which I have formed after eight years of close study of the problem of live stock improvement in India

SYSTEMATIC BREEDING CONTROL IN THE VILLAGES GENERALLY MOST EFFECTIVE

For improvement on the vast scale which is needed, it is obvious that few Governments can afford to undertake the actual breeding on Government farms, of sufficient numbers of suitable sires Nor can they afford to maintain the large numbers of special staff which would be required for systematic live stock improvement throughout the country, in addition to the extensive provincial Veterinary Departments which, owing to the lack of veterinary practitioners in India, Provincial and State administrations are compelled to maintain for the control of disease

SUITABLY TRAINED STAFF DEVOTED TO LIVE STOCK ESSENTIAL

Experience has, moreover, shown that it is generally more effective and cheaper to help and encourage village breeders to improve their own stock, by systematic breeding and disease control in the villages, than to attempt to breed the very large numbers of sires required, but this can only be done where adequate and suitably trained staff exists, in close touch with the live stock of the country Such staff, suitably distributed at veterinary hospitals or other centres is therefore essential and as it is not possible to deal with the whole country at once, it follows that control should first be concentrated in the areas where the best recognized breeds are at present found and where the breeding of improved live stock is economically feasible Before deciding on a plan of campaign, it is thus necessary to make a rough survey to determine broadly the areas in which definite types at present exist and to choose suitable breeding centres, for each breed at which suitably trained personnel is likely always to be available to carry on the systematic control, which is necessary for lasting progress.

Pedigree registration necessary

It is true that some improvement, particularly in the first generation, can be achieved by buying non-pedigree bulls and issuing them to villages where the cattle are poor, even where strict breeding control does not exist. But lasting progress cannot be expected unless arrangements are made to provide an adequate supply of sires whose genetic origin is known and to carry on systematic registration, not only of bulls and their progeny but also of selected cows whose approved progeny could in course of time be registered as pedigree stock. This seems to me the only way in which it will be possible to provide, throughout the country, for the gradual breeding up of a cadre of pedigree stock, which could eventually be drawn upon to provide the great numbers of pedigree animals which are needed for systematic live-stock improvement.

Best cattle in areas where free grazing is scanty

It will probably be found that the areas in which the best cattle are bred, and which should be developed first, are areas in which free grazing is scanty and where attention is paid to the production of fodder crops to supplement such free grazing as is available. Under fodder crops, I include cultivated or properly managed grazing, the most valuable of all fodder crops, and grain crop residues of good feeding value such as *kadbi.*

It has in fact been found in India, as in other countries, that if full advantage is taken of the manurial effect of their urine and dung, the gross return from the land and profit per acre can be greatly increased by well-fed live-stock under a balanced system of mixed farming. Moreover, properly managed live-stock, besides increasing the return from the land, has the effect of equalizing the income over a series of years, while in mixed farming a large proportion of the return is obtained from animal products, such as dairy products, without which it is not, as a rule, practicable to provide a satisfactory diet for the people, and at the same time comparatively high priced work-cattle can be bred. For these reasons, I have for years past advocated that mixed farming with reasonably high yielding cows should be adopted wherever possible as likely to be the only way of enabling agriculture in India to meet the ever-increasing pressure on the land.

Foreign breeds unnecessary

The improvement of live-stock, and of cattle in particular, is indeed a matter of great social as well as economic importance and urgency in India and it is necessary to emphasise that it has now been amply shown that it is unnecessary, and unsound as a general policy, to attempt to introduce European breeds of cattle into India. Systematic investigation, carried out by the Animal Husbandry Bureau of the Imperial Council of Agricultural Research, has shown that, by careful selection and proper feeding and management, herds of pure Indian dairy cattle have already

been produced within twenty five years, which can more than hold their own in India, with European cattle and with the best Indian buffaloes, in economy of milk and butter fat production [Kartha, 1934] Already they exceed the average milk yield of commercial dairy herds in Europe and America and there is every evidence that these results are likely to be steadily improved upon for years to come, while it has clearly been demonstrated that, even with the best of care and under the best possible conditions cattle of European origin always tend to degenerate in India

Nor should it be forgotten that, if a policy of using imported cattle were adopted, it would be necessary to keep up, year after year, a huge supply of pedigree sires, purchased abroad at very high prices the cost of which would generally be prohibitive Without most careful and expert breeding control, the use of foreign cattle for stud purposes is moreover very dangerous Indeed, it has already done incalculable harm by destroying valuable pure bred herds of Indian cattle by unscientific mating

Systematic breeding control in villages by an expert department devoted solely to live stock

It is far sounder, therefore, to effect systematic improvement by means of selective breeding and better feeding and management of indigenous stock than to attempt to grade them up by the importation of stock of European origin Systematic breeding control by a suitably trained Government Department, devoted solely to the interests of live stock, thus appears to be the only sound policy and it is now clear that the most far reaching results so far obtained in India have been secured under some system of providing approved sires , purchased as far as possible from breeders in the best breeding areas and issued under subsidy or on concession terms under the supervision and control of such a Department

Issues on part payment system

Probably the cheapest, most effective and lasting method of all appears to be to purchase suitable sires in the best breeding areas and to issue them under some system of part payment , the animals becoming the property of their allottees as soon as their total cost has been repaid to Government, in annual instalments Some such system has been extensively adopted in various parts of India and the following terms are suggested as likely to prove suitable —

(*a*) When a village in a cattle breeding tract requires a new bull, the local representative of the department responsible for cattle breeding should arrange, in collaboration with the principal breeders of the area concerned to purchase a suitable bull, either in the same area or from an area where a better class of animal of the same breed can be obtained

(*b*) The bull should be issued to a selected custodian, on payment of 25 per cent of the cost price, and a register kept by the department of his services and progeny, the allottee being permitted to charge a reasonable service fee on the condition that the bull is always well-fed and exercised and preference given to registered females.

(*c*) At the end of the first year and each following year, the allottee should pay a further 25 per cent of the cost price, until the whole has been repaid to Government.

(*d*) The bull would then become the property of the allottee who would be at liberty to sell or otherwise dispose of it but not to retain it for service in the same area beyond the 4th year, by which time a fresh bull should be available, supplied by Government on the same terms, so as to obviate a bull covering his own daughters.

(*e*) Normally provided that he had proved a satisfactory custodian, a new bull would be issued to the same allottee as before, who would thus continue to pay to Government each year, 25 per cent of the cost of a new bull.

Economical method of employing Government funds

In this way, the bulk of the funds provided by Government for the supply of suitable bulls could be recovered and a great deal done for the systematic improvement of cattle at comparatively small cost. Should the bull die or prove unsatisfactory, the loss should, however, be borne by Government as a part of their contribution to departmentally controlled live-stock improvement.

Such a system has the advantages that it provides a remunerative market for well-developed young males from registered parents and, as the bull eventually becomes his own property, it would be in the custodian's interest to look after it properly.

It may be necessary to pay a small subsidy to ensure proper maintenance but experience has generally shown that there is not much difficulty in finding suitable custodians willing to take bulls on such terms and that wherever it is possible to purchase suitable bulls from breeders, under some such system, a great stimulus is given to better breeding and proper care and management of stock.

Cows must also be registered

To get the best out of such a system, it is necessary that a few of the very best cows in the areas served by approved bulls should also be registered and they and their approved progeny tattooed as selected stock. Where good cows do not exist, it may be necessary to buy a few and issue them on similar terms to selected ryots, on their undertaking to feed them properly and mate them regularly with approved bulls. Such cows should obviously be of the same breed as the approved bulls working in the district and should be good milkers. Registers of all such

stock should be maintained at veterinary hospitals or other suitable centres, and annual cattle shows should be held at suitable fairs at which prizes and *sanads* would be given and suitable young bulls selected annually, for purchase by Government

To ensure proper development of these and to carry on systematic breeding of the very best strains available, particularly of dairy breeds, it will generally be found advisable for each Government to maintain at least one central breeding and rearing farm, within easy distance of a city where some experimental breeding can be carried on and a dairy maintained at moderate cost, and where elementary provincial instruction could be given in dairying and animal husbandry

In order to build up an adequate cadre of pedigree animals within a reasonable space of time, it might be advisable also, for the first few years, to select, at local shows, a small percentage of the best heifers by approved bulls, but not out of registered dams, and to mark them as selected females whose progeny would become eligible for registration as pedigree stock, if found suitable in following generations

Any stock produced from these females, by a pedigree bull, would in any case be considerably enhanced in value but to ensure proper care and supervision of all registered females and their progeny, it would be necessary to refuse to register any young stock not up to standard , in size as well as conformation and type

Registration should in fact be withdrawn if pedigree females or their progeny are not maintained in good condition or if a cow has proved an unsatisfactory breeder

Prices paid by Government for young bulls must be remunerative

It is essential that the prices paid by Government for sires should be sufficient to encourage local breeders to feed their breeding females and young stock well and, before issuing a bull to a village, Government should insist that all other bulls in the areas to be served by approved bulls, are castrated or otherwise disposed of

Systematic castration essential

In any policy of live stock improvement, one of the most important items must be the vigorous prosecution of systematic castration to eliminate all scrub bulls before they are old enough to commence service Unfortunately the very degenerate scrub bulls commonly seen are very active servers and unless this side of the problem is successfully dealt with, little permanent progress can be expected This work could under veterinary supervision be carried out by suitably trained stockmen along with other animal husbandry work

Animal husbandry department essential devoted solely to live stock

The above are the general lines but pedigree breeding is expert animal husbandry work which can be satisfactorily controlled only by suitably trained staff

devoted solely to live-stock. It cannot be done by men, however trained, whose interest in live-stock is only subsidiary. In every province or state there should *therefore be an expert department capable* of undertaking systematic breeding control along these lines ; particularly in the best breeding centres for each important breed.

In addition to exercising systematic control of breeding operations and carrying on systematic castration and inoculation against disease, the animal husbandry department should maintain registers of all pedigree stock and should be responsible for the periodical inspection of all animals which are the property of Government or under subsidy, and should also keep in touch with their progeny.

Properly trained stockmen needed

To carry out this class of work, on the very big scale which is needed, some cheaper staff than qualified veterinarians will probably be found necessary and, if adequate progress is to be made, it seems certain that, as recommended by the Animal Husbandry Wing of the Board of Agriculture, it will be necessary to supplement provincial or state veterinary departments by employing suitable stockmen who, after six months veterinary training, could assist veterinary assistant surgeons in carrying out systematic castration and inoculation against disease and in the tattooing, registration and inspection of pedigree stock.

While carrying out this work in the villages, stockmen would be brought in close contact with village live-stock, of all kinds, and should be of great assistance to provincial veterinary departments in obtaining early information of disease. For this reason and to ensure proper supervision of castration and inoculation, it is clear that all stockmen should be under veterinary control.

By these means the whole of the provincial veterinary staff could be made full use of for systematic live-stock improvement and it should certainly be cheaper to strengthen existing veterinary departments by providing specially trained men in special lines such as dairying, sheep and goats and poultry than to attempt to provide the very large numbers of special staff which would be required if veterinary staff were not employed for live-stock improvement. Such specially trained men are necessary to form properly constituted animal husbandry departments capable of dealing authoritatively with every branch of animal husbandry work and should in any case be provided.

Class of cattle to be bred

Obviously the decision as to the class and breed of cattle to be used for breeding purposes is a matter of the first importance. As a general rule, it can be taken that where reasonably well-developed and efficient cattle already exist, it is sound policy to endeavour to raise them to higher standards, by selective breeding combined with better feeding and management and effective disease control. For

such work the method of issuing bulls on part payment and registration suggested above should prove the most satisfactory

DEGENERACY USUALLY DUE TO FAULTY FEEDING

In areas where cattle are hopelessly degenerate and inefficient, it may be taken that the main cause is improper feeding due, as for example, is commonly the case throughout the rice breeding tracts, to feeding mainly on defective fodder or to some mineral or other deficiency in the food stuffs available in the locality For example, it has recently been shown that there are large areas in India where mineral deficiencies are so marked a feature that the breeding of good cattle is impracticable without special feeding Other observations have shown that vitamin deficiencies are liable to be of great importance to stock breeders in areas where there is a long dry period, unless adequate provision is made for the growing of fodder or semi fodder crops which can be fed green in sufficient quantity to maintain health throughout the year On the other hand my own observations supported by data obtained from farms under Government control in different parts of India, show that, with proper feeding and management, well developed, efficient cattle can be produced and maintained except in areas, such as certain parts where the whole country is badly waterlogged during a great part of the year or where cattle are so infested with biting flies, ticks and other parasites that it is difficult for them even to maintain life

BEST CATTLE BRED IN DRIER TRACTS

As a general rule, it can be taken that throughout India the best cattle are bred in the drier tracts where free grazing is scanty and the grass grown is not coarse and this fact may be taken as a sure indication that the coarse grass produced in forest areas, under heavy rainfall conditions, is not sufficiently nutritious to produce good stock In wet areas it is unlikely therefore that much improvement can be effected by the mere introduction of stock accustomed to drier conditions and more highly nutritious food stuffs The policy should therefore be to endeavour to improve the local breeds by careful selection and systematic animal husbandry work designed particularly to provide better fodder and to control parasites which, in such areas, are nearly always a serious cause of degeneracy and ill health

In the rice tracts the degeneration of cattle which occurs appears to be largely due to the fact that the people are not cattle minded and take no steps to provide nutritious and health giving fodder or semi fodder crops such as the legumes and grasses or *juar kadbi* which are extensively grown by cattle breeders in districts where the best stock are bred and reared It seems however, that crops of this kind could usually be produced in the rice tracts if suitable seed were thrown in on the last watering of the paddy fields

NECESSARY TO DEMONSTRATE THE VALUE OF WELL-FED MILCH CATTLE

In areas where the cattle are hopelessly poor and inefficient, it may even be necessary to introduce better stock from other parts of India to demonstrate to the ryot that good cattle, and in particular milch cattle, are very profitable if properly fed and maintained on the holding in such a way as to ensure that as little as possible of the manurial value of their urine and droppings is wasted. With a view to making rice growers more cattle-minded, I have recommended to provinces and states within easy reach of Calcutta that they should take advantage of the opportunity of obtaining good Hariana cows there, at moderate prices, and hand them over to selected ryots, on part payment terms, on the condition that the allottees undertake to introduce a sufficient proportion of suitable legumes or grasses into their rotation to supplement the usual rice straw ration. Such a system should make economical milk production possible and should enable the stock to be maintained in better condition all the year round. I have also suggested that a sufficient quantity of silage should be made for each of these cows from young grass or a leguminous or other suitable crop, quantities of which could be grown during the monsoon in such areas and cut at an early stage of growth, to ensure that sufficient succulent fodder would be available during the dry season. Under departmental supervision such cows should prove a valuable source of additional income besides producing useful young bulls or bullocks and should be useful as an object lesson not only to the allottees but to their neighbours as to the value of superior stock if properly fed. For rice tracts within easy reach of Calcutta, I have therefore recommended small type compact Hariana bulls and they are doing well and proving highly popular. In similar areas, not within easy reach of Calcutta, I have in the past recommended Tharparkar cattle and I consider that they or, even better, good Rath cattle should prove the most suitable. Both are very compact and hardy and good milkers and Rath cattle in particular are quick, active workers.

FODDER-CROPS ESSENTIAL

It is a truism that no good stock can be bred without proper feeding and management and that the best blood in the world is useless unless it can be given the best opportunity to express itself in development. I have already mentioned that throughout India the best cattle are to be found in areas where free-grazing is scanty and where in consequence stock-owners are compelled to grow sufficient nutritious fodder-crops or semi-fodder crops to supplement such free grazing as may be available. Throughout vast tracts of India these facts are however either not known or ignored and attempts are made to provide for the want of really efficient cattle by maintaining large numbers of poor stock, on free grazing, which are incapable of producing useful work bullocks and are of little value either as milk producers, or as soil fertilizers, since their droppings are mostly deposited on land not under cultivation. To emphasize this point it may be mentioned that

while a good pair of well developed oxen may easily fetch from three to four hundred rupees it is possible to obtain large numbers of the poor type of bullock bred in forest areas, where coarse grass is produced in large quantities, at an average of Rs 10 a head

MILK AND DAIRY PRODUCTS AN IMPORTANT SOURCE OF PROFIT TO CATTLE BREEDERS

We have recently had well authenticated figures from a large number of cattle-breeders which show that though the breeding of work bullocks is regarded as their main business, the profit derived from the sale of moderate priced bullocks bred mainly on free grazing is small compared with what is derived from the milk or other dairy produce obtained from their mothers The truth of this has been verified in other parts of India, where conditions are quite different, and if full benefit is to be derived from Indian agriculture, it is, I believe, essential that more should be made of the milk which, by proper feeding and management, under a proper system of mixed farming, could be derived from the mother of the working ox As a side line of mixed farming milk can in fact be very cheaply produced and, provided that arrangements can be made to provide a steady market, might well prove the most profitable of all cottage industries and one which the women folk of the family could usually undertake Indeed to increase fertility and the return from crops every cultivator should devote a sufficient proportion of his land to the production of fodder or suitable leguminous crops so that the whole area would come under such crops and be grazed by stock at least one year in every five or six

CULTIVATION OF LEGUMINOUS AND OTHER FODDER CROPS SHOULD BE ENCOURAGED

The cultivation of leguminous and other fodder crops such as lucerne, berseem, *senji*, *guara*, Sudan and Guinea grass and crested wheat grass and semi fodder crops such as *juar*, should therefore be encouraged and the great value of a reserve of ensilage for use in the dry season should be explained Reasonable concessions to cultivators to grow such crops should be given and every effort should be made to popularize silos for conserving grass or green crops cut at an early stage of growth Experience has in fact shown that valuable working cattle can be satisfactorily bred and maintained on the holding, by growing legumes and fodder crops in the rotation, and that their owners, in addition to producing useful work bullocks can thereby obtain a most valuable addition to their income, from suitable cows

MORE MILK SHOULD BE BRED INTO INDIAN BREEDS OF WORK CATTLE

Such a system, however, postulates the breeding of a reasonable amount of milk into the recognized working breeds and I am sure, from my own observations and from the observations of experienced breeders of Indian cattle that, up to milk yields considerably beyond what would be necessary, this can be done without damage to the stock as work animals

Production of cheap milk

Probably the greatest boon which any philanthrophist could confer on India to-day would be to at least double the total output of milk. To do so is, however, no easy matter. Milk production on special dairy farms is only profitable where there is an easily accessible market for liquid milk, at prices much higher than the poor can pay, and it seems that reliance will have to be placed on the production of milk as a side line of mixed farming if cheap milk is to be made available in adequate amounts throughout the country. The production of milk, at the same time as useful bullocks, as a cottage industry, supplementary but subsidiary to the main activities of the cultivator, in fact appears to be the only solution.

Government and wealthy philanthrophists ought therefore to do every thing possible to encourage this by investigating the problems involved in the handling, processing and transportation of milk under Indian conditions and in the manufacture of ghee, *khoa*, etc., and by establishing collecting centres at suitable points, all over the country, at which a steady market would be made available, all the year round, for milk, cream, ghee and other cottage produce such as eggs and honey. They should also assist poor cultivators to secure good cows as well as reliable seed from which to produce the succulent fodder-crops which are necessary to make even the best cows really profitable.

The prices given at such centres need not be high. Indeed it would be a mistake to make them so because the main purpose should be to bring milk and dairy produce in India to price levels at which poor people would be able to buy them in reasonable quantities. At present milk, even at the rates at which it is obtainable in rural areas, is much more costly than in countries where dairying is a well-organized rural industry and, for years past, I have emphasized that until steady markets are provided in rural areas, at which small producers can be assured of a steady outlet for their produce, very little can be done.

On the other hand there is ample experience to show that wherever such centres have been established, in various parts of India, the supply of milk has rapidly increased and the villagers have become more prosperous.

The usual system is to obtain cows through the milk-buyer and to pay for them in milk so that the cows eventually become the sole property of the milk producer.

Calves should be weaned

In this connection, it is of the greatest importance that village producers should be taught that it is easily practicable and profitable to wean the calves of Indian cows at birth and rear them by hand, in the same way as has become the universal practice in all progressive dairy countries. Until it is, little general progress can be hoped for in improving the average yields of Indian breeds of dairy cattle but the general adoption of this practice would have a very beneficial and far reaching effect on the development of dairying in India.

Harm done by lack of green fodder during winter

The need for fresh green fodder to keep animals in health is well recognized all the world over but in many parts of India there is difficulty in obtaining any fresh growth for several months each year and during the past few years we have obtained definite evidence that a great deal of harm is done to breeding stock owing to the lack of essential vitamins which this lack of fresh green food entails For example, on a certain farm where the lack of fresh green food was extreme, as many as 40 per cent of otherwise well fed and managed cows, which did not receive any green food for several months each year, produced blind or otherwise badly developed calves which usually did not survive and if they survived were of no value A careful study of their feeding and investigations carried out at the Mukteswar Research Institute, has shown that this condition was due entirely to lack of green food and since an adequate supply of locally grown green fodder has been made available the cows have produced normal calves, thus making it possible again to carry on breeding satisfactorily in this herd This was an extreme case but it is clear that a great deal of harm is done, each year, to cows which have an inadequate supply of freshly grown green fodder and that every effort should be made to provide a sufficient supply of such fodder, or silage prepared from young grass or other immature fodder crop, all the year round

Other classes of stock dealt with on similar lines

Sheep, goats, poultry and horse breeding could be dealt with from veterinary hospitals or other suitable centres along similar general lines, by providing suitable sires or breeding units on an instalment system of payment In this way pedigree breeding could be carried on under the supervision of the department concerned, and this department, besides obtaining suitable breeding stock and arranging for the necessary exchanges of males, should be responsible for giving advice as to the proper care and treatment of stock, in health as well as in disease

REFERENCE

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THE QUALITY OF SUGARCANE IN NORTHERN INDIA IN RELATION TO BORER INFESTATION AND DISEASE INFECTION

BY

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In the September 1937 issue of *Agriculture and Live-stock in India*, there appeared an article by one of the subscribers, giving in detail the results of a borer survey made over the supplies of cane delivered during February 1937 to ten factories situated in Northern India and whose operations are controlled by Messrs. Begg Sutherland & Co., Ltd., Cawnpore.

With a view to ascertaining whether there had been a decrease or increase in the degree of infestation a survey was again carried out in February 1938 but on a more extensive scale.

The areas from which the factories drew their supplies were divided into circles so that a comparison of the quality of the cane in respect of each circle could be determined from the results of the survey. The examination of the cane was made at the factories and every precaution was taken to make the survey representative of (*a*) the circle whence supplies of cane were drawn and (*b*) the material delivered to the factory. The procedure adopted was to draw at random from the cane carts or railway wagons, the source from which the cane was supplied being known, one hundred stalks of cane. The stalks were then split longitudinally and after a count of the number of sound and infested stalks, weighment of the sound and infested cane was made. A stalk although only showing the slightest degree of infestation was classed as infested and the latter included canes which, while not showing evidence of actual wound injury from borer, presented symptoms of disease as shown by the presence of discoloured pith. Finally, the sound and infested canes were subjected to analysis which included the determination of solids, sugar and purity of the juice expressed by a hand mill. From these analyses, passage to the composition of the cane and to the yield of sugar in the factory was made according to the scheme given in detail on pp. 600-601 of the September 1937 issue of *Agriculture and Live-stock in India*.

Factory No. 3.—Twenty-eight circles were examined at this unit and during the survey 11,500 stalks were examined, 4,201 of which were found to be infested, representing a 36·53 per cent degree of infestation or an increase of 1·73 per cent over that determined in February 1937. The lowest degree of infestation is recorded at 14·00 per cent for circle No. 13 while the maximum is given as 55·5 per cent for circle No. 24 which indicates the variation in borer infestation as from circle to circle whence this unit draws its cane supplies.

According to the proportion per cent total supplies from each circle, the yield of sugar from sound cane during the month of February 1938 would have been 10·66 per cent as compared with 7·61 per cent from infested cane, while the average yield from mixed supplies is given as 9·52 per cent which compares very favourably with an actual sugar yield of 9·49 per cent recorded by the factory. Since this unit crushed 5,15,188 maunds of cane during the month of February 1938, the loss of commercial sugar due to borer attack and disease may be estimated at $5{,}15{,}188 \times (10{\cdot}66—9{\cdot}52)/100 = 5{,}873$ maunds, equivalent to a depression in the sugar yield of 1·14 per cent on cane.

Factory No. 4.—Only four circles were surveyed and from an examination of 7,800 stalks of cane, 3,357 were found to be infested indicating an infestation degree of 43·04 per cent or a decrease of approximately 13 per cent from that recorded for February 1937. This marked decrease in the degree of infestation is reflected in the results recorded by this unit in February 1938, since an actual yield of 10·62 per cent was obtained as compared with 8·64 per cent for February 1937. Nevertheless, it will be observed from Schedule IV that the yield from sound cane would have been 12·31 per cent as compared with 8·17 per cent for infested cane, and, 10·54 per cent for mixed supplies which compares very favourably with an actual yield of 10·62 per cent as recorded by the factory for the month of February 1938. Although there has been a marked improvement in the quality of supplies delivered to this factory, an infestation degree of 43·04 per cent has been responsible for a loss of 9,125 maunds of commercial sugar.

Factory No. 5.—Schedule V indicates that five circles were surveyed and from an examination of 9,500 stalks of cane, 4,034 stalks were found to be infested, indicating a 42·46 per cent infestation degree or an increase of 2·46 per cent over and above that recorded for February 1937. Also it may be noted that the degree of infestation is very uniform for all circles.

According to the analyses of sound and infested cane, the average sugar yield from mixed supplies is estimated at 10·87 per cent as compared with an actual factory yield of 10·78 per cent, but, if all supplies had been sound, the estimated yield would have been 12·18 per cent representing a loss of 7,795 maunds of commercial sugar due to borer and disease. For February 1937, the estimated yield from mixed supplies was given as 10·15 per cent as compared with 10·87

per cent for February 1938 but a reference to Schedule XI will indicate that the improved sugar yield can be attributed to an increase in the sugar content not only of sound cane but also of infested cane

FACTORIES SITUATED IN EASTERN UNITED PROVINCES

Factory No 6—Nine circles were surveyed at this unit and Schedule VI indicates that 5 846 stalks were infested from a total of 18 200 stalks examined representing an infestation degree of 32 12 per cent as compared with 31 11 per cent reported for February 1937

The analyses results indicate that this unit would have recorded a sugar yield of 11 20 per cent from sound cane as compared with 8 45 per cent from infested cane while the estimated yield from mixed supplies on a weighted average basis is given as 10 43 per cent which compares quite favourably with an actual factory yield of 10 32 per cent for the month of February 1938 As this factory crushed 5 03 377 maunds of cane during the month under review the estimated loss of sugar is given in Schedule VI as 3 876 maunds

Factory No 7—Schedule VII gives the detailed results of borer survey for eleven circles supplying cane to this factory and from a total of 12 871 stalks of cane examined 5 514 stalks were found to be infested representing an infestation degree of 42 84 per cent or a decrease of 2 82 per cent in the infestation degree from that recorded in February 1937 The minimum infestation degree is 34 98 per cent for circle No 4 and the maximum 62 8 per cent for circle No 7

According to the analyses results of sound and infested cane the average sugar yield from mixed supplies is estimated at 10 93 per cent as compared with an actual factory yield of 10 67 per cent but if all supplies had been sound the estimated yield would have been 11 98 per cent representing a loss in February 1938 of 5 841 maunds of commercial sugar due to borer and disease attack

From Schedule XII which gives the comparative analyses factors obtained from the surveys carried out in February 1937 and 1938 it may be noted that the quality of the sound and infested cane examined in February 1938 was much superior to that examined in 1937 even although an infestation degree of 42 84 per cent has been recorded

Factory No 8—Eight areas were surveyed at this unit and from Schedule VIII it may be noted that 1,464 stalks were found to be infested from a total of 7,900 stalks examined indicating an infestation degree of 18 53 per cent as compared with 17 33 per cent as reported for February 1937

The analyses results indicate that this unit would have recorded a sugar yield of 11 58 per cent if all supplies had been sound, whereas, the estimated

Provinces respectively From these schedules it will be noted tha for the group of five factories in North Bihar 52 290 stalks of cane were examined in February 1938 as compared with 23 850 stalks examined in February 1937, while the degree of infestation is given as 38 75 per cent or a decrease of 2 57 per cent from the percentage recorded for February 1937 As the borer survey results carried out in February 1937 revealed the severe losses of available sugar which a factory would suffer if infested cane was milled a stricter supervision over the supplies during season 1937 38 was maintained at all units and as many rejections of supplies were made this factor may have contributed to a certain extent in a decrease of 2 57 per cent in the infestation degree from that determined in February 1937 Although it is gratifying to record a decrease, even although it may be small an average infestation of 38 75 per cent for the supplies at the cane carrier is most serious since the estimated loss of commercial sugar due to borer and disease infestation for the five factories in North Bihar for February 1938 amounts to 33 528 maunds

Although a stricter supervision was also maintained over the supplies to the five factories situated in the Eastern United Provinces it will be noted that from a total of 55 094 stalks of cane examined 17,134 stalks were found to be infested representing an infestation degree of 31 10 per cent or an increase of 2 03 per cent over that determined in February 1937 It will be of interest to note from the average analyses of the sound cane for factories in North Bihar and Eastern United Provinces that the sugar content of the cane is given as 13 45 and 13 57 per cent respectively, while the estimated extraction from mixed supplies is quoted at 10 27 and 10 84 per cent respectively which compares very favourably with the actual group sugar yields of 10 24 and 10 72 per cent respectively The lower yield of sugar by the group of factories in North Bihar can be solely attributed since the sugar content of the sound cane is very similar to the fact that supplies of cane to the factories in North Bihar were infested to the extent of 38 75 per cent as compared with 31 10 per cent for supplies to the factories in the Eastern United Provinces It may also be of interest to note that the average purity of the juice extracted from the infested cane is quoted at 79 99 and 82 31 per cent for the factories situated in North Bihar and in the Eastern United Provinces respectively, while the average sugar content for the Bihar group is given as 10 50 per cent as compared with 11 23 per cent for the Eastern United Provinces group which would appear to indicate that the borer and disease attack of the cane crop in North Bihar has been more virulent than in the Eastern United Provinces Nevertheless, a loss of 16 689 maunds of commercial sugar for the Eastern United Provinces group is of such a serious nature that every available means should be adopted to reduce or eradicate the borer pest

From the results of analyses, etc , obtained from the surveys carried out in February 1938, the writers feel justified in making the following further state

ments. (These are in addition to those already made in the survey of February 1937) :—

1. From observations made over a period of years, the cane crop in North Bihar and Eastern United Provinces rapidly matures from the beginning of December until the beginning of April, the sugar content of the cane increasing from approximately 10 per cent to 13·5 per cent. However, where the cane crop was heavily infested, it has been noted that the cane gradually matures until approximately 12 per cent sugar is recorded in mid-January, but, after this period there is little or no increase and in mid-March the cane rapidly deteriorates. With a view to ascertaining whether there was a progressive loss of sugar throughout a season, when the cane had been attacked by borer or disease, an extensive survey was carried out at one unit and it was definitely established that there was a progressive loss since in *January, February and* March, the estimated loss in yield of sugar was calculated to be 0·56, 0·79 and 0·91 per cent on cane respectively.

2. Numerous tests have proved that the juice extracted from the sound part of a stalk of cane which has been attacked by borer is approximately four to six units lower in purity than the juice from an entirely sound stalk of cane.

3. From Schedules XI and XII it may be noted that there has been a considerable decrease in the weight per 2,000 stalks of sound cane reported in 1938 as compared with that for 1937, the average percentage decrease amounting to approximately 13·5 per cent for the Bihar group and 9·5 per cent for the Eastern United Provinces group.

   Attention may also be particularly directed to the relative low weight per 2,000 stalks of cane recorded by Factory No. 2 as compared with the weight reported, say, by Factory No. 5 also situated in North Bihar.

4. Although a much stricter supervision has been maintained over the supplies of cane to the group of ten factories, and many rejections have been made on account of borer infestation and disease, attention is drawn to an average infestation of 38·75 and 31·10 per cent for the group of factories situated in Bihar and Eastern United Provinces respectively. Due to the many rejections which have been made and the cane which the cultivator does not tender to

the factory on account of its poor condition due to insect pest attack, these degrees of infestation cannot be taken as truly representative of the cane crop in Northern India

5 The financial loss to the miller can be fairly accurately estimated, since the results from the borer survey indicate that the group of ten factories during the month of February 1938, suffered a loss of 50,217 maunds of sugar or a financial loss of some Rs 3,75 000 quoting sugar at Rs 7 8 per maund

6 Apart from the loss to the grower and miller the question has a national aspect in so far as the Excise and Imperial Revenues suffer from the depleted yield In item 5, the estimated loss to the group of ten factories during the month of February 1938 was given as 50,217 maunds of sugar and with the Sugar Excise Duty at Rs 1 8 per maund the revenue loss to Government would approximate Rs 75 000 On the assumption that the loss in February is representative of the average monthly seasonal loss, the loss in revenue to Government over a season of five months would amount to some Rs 3,75 000 Since there are some 65 factories operating in North Bihar and Eastern United Provinces and assuming that the quality of the cane milled by the group of ten factories is representative of the supplies to all factories, the revenue loss on Sugar Excise to Government may be estimated to approximate Rs 24,00,000 during the year under review.

SCHEDULE I

Factory No. I

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	822	291	19·62	85·81	13·30	11·40	578	205	17·96	80·09	11·06	9·11	17·39	1·82	1·98	1·58	41·29
Circle 2 .	701	210	19·54	85·82	13·25	11·36	489	177	17·97	80·80	11·04	9·09	9·72	1·01	1·10	0·88	40·78
Circle 3 .	712	244	18·90	85·40	12·76	10·90	488	180	17·14	79·28	10·33	8·37	5·34	0·52	0·58	0·15	40·67
Circle 4 .	738	209	19·73	86·54	13·50	11·63	462	182	17·96	80·45	10·81	8·97	19·86	2·09	2·31	1·78	38·50
Circle 5 .	814	290	19·30	85·49	13·03	11·14	586	213	17·46	79·81	10·59	8·61	11·83	1·19	1·32	1·02	41·86
Circle 6 .	800	209	19·74	86·48	13·19	11·59	600	214	17·86	80·82	10·98	9·03	27·76	2·90	3·22	2·51	42·86
Circle 7 .	669	232	19·39	85·72	13·13	11·21	531	180	17·68	80·33	10·84	8·81	3·74	0·38	0·42	0·33	44·25
Circle 8 .	700	239	19·41	85·61	13·13	11·27	700	247	17·52	80·28	10·73	8·75	4·36	0·44	0·49	0·38	50·00
Totals and Averages.	5956	2014	19·45	85·85	13·20	11·31	4434	1598	17·69	80·35	10·80	8·84	100·00	10·35	11·12	8·93	42·68

Factory Results :—

Cane crushed during February . . . . 5,71,581 maunds
Sugar made during February . . . . 58,560 maunds
Yield of sugar per cent cane . . . . 10·25 per cent

Borer Survey :—

Yield of sugar from mixed cane . . . . 10·35 per cent
Yield of sugar from sound cane . . . . 11·42 per cent
Yield of sugar from infested cane . . . . 8·93 per cent

Loss of sugar due to borer infestation and disease 5,71 581 × (11·12—10·35)/100 = 6,116 maunds.

SCHEDULE II

Factory No 2

Area	Sound cane: No of stalks	Sound cane: Weight in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No of stalks	Infested cane: Weight in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage Infestation on No. of stalks
Circle 1	840	235	19 93	83 26	12 78	10 59	360	98	17 57	77 66	10 07	7 83	14 08	1 37	1 49	1 11	30 00
Circle 2	823	230	20 13	84 03	13 03	10 89	377	103	17 98	80 00	10 62	8 53	11 13	1 13	1 21	0 95	31 42
Circle 3	773	209	20 13	84 34	13 07	10 95	427	113	17 69	79 12	10 34	8 22	6 38	0 64	0 70	0 52	35 58
Circle 4	510	146	20 29	84 72	13 15	11 03	490	138	17 30	79 39	10 17	8 11	0 52	0 05	0 06	0 04	49 00
Circle 5	876	234	20 21	84 22	13 11	10 98	324	84	17 91	78 30	10 41	8 17	5 88	0 60	0 65	0 48	27 00
Circle 6	844	230	20 43	85 04	13 38	11 28	356	99	18 10	80 03	10 80	8 67	7 00	0 74	0 80	0 61	29 67
Circle 7	568	163	20 37	85 21	13 40	11 31	432	124	17 55	79 18	10 28	8 19	4 01	0 40	0 45	0 34	43 20
Circle 8	788	217	19 00	84 17	12 70	10 63	312	87	17 47	79 94	10 30	8 17	19 70	1 96	2 09	1 61	28 36
Circle 9	794	211	20 12	83 73	12 91	10 76	306	80	17 09	77 64	8 92	7 63	9 84	0 93	1 05	0 75	27 82
Circle 10	719	197	20 11	84 82	13 13	11 04	281	75	17 87	79 85	10 54	8 44	3 55	0 37	0 39	0 30	28 10
Circle 11	566	161	19 77	83 75	12 75	10 59	234	67	17 63	80 12	10 43	8 40	11 86	1 18	1 26	1 00	29 25
Circle 12	764	201	20 22	84 06	13 13	10 98	336	89	17 80	80 01	10 66	8 56	5 96	0 60	0 65	0 51	30 55
Totals and averages	8865	2434	20 11	84 25	13 04	10 91	4235	1157	17 67	79 26	10 30	8 24	100 00	10 02	10 81	8 22	32 33

Factory Results —

Cane crushed during February	5 84 710 maunds
Sugar made during February	58 511 maunds
Yield of sugar per cent cane	10 01 per cent

Borer Survey —

Yield of sugar from mixed cane	10 02 per cent
Yield of sugar from sound cane	10 81 per cent
Yield of sugar from infested cane	8 22 per cent

Loss of sugar due to borer infestation and disease 5,84 710×(10 81—10 02)/100=4 619 maunds

SCHEDULE III

Factory No. 3

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	848	287	19·53	86·32	12·75	10·67	452	155	17·06	79·41	9·75	7·58	17·0	1·62	1·81	1·20	34·77
Circle 2 .	1270	444	19·67	86·25	12·84	10·71	630	225	17·24	79·42	9·88	7·67	20·5	1·99	2·20	1·57	33·16
Circle 3 .	313	92	19·50	85·93	12·67	10·56	187	57	17·07	79·83	9·80	7·62	3·8	0·36	0·40	0·20	37·40
Circle 4 .	127	43	19·83	86·40	12·95	10·82	73	25	16·92	79·31	9·65	7·50	0·5	0·04	0·05	0·04	36·50
Circle 5 .	120	39	20·05	86·61	13·15	11·00	80	25	17·61	80·12	10·18	7·97	1·5	0·15	0·17	0·12	40·00
Circle 6 .	422	159	19·76	86·33	12·92	10·80	278	112	17·01	79·66	9·75	7·58	8·4	0·79	0·91	0·64	39·71
Circle 7 .	396	117	19·36	86·39	12·63	10·57	204	67	17·06	80·26	9·82	7·69	6·2	0·59	0·66	0·48	34·00
Circle 8 .	370	119	19·30	86·45	12·62	10·57	220	74	16·94	79·87	9·76	7·60	3·5	0·33	0·37	0·27	37·29
Circle 9 .	77	23	19·67	85·30	12·60	10·36	33	10	17·76	79·50	10·18	7·86	0·3	0·03	0·03	0·02	33·00
Circle 10 .	158	56	18·71	85·75	12·11	10·01	42	12	16·68	78·55	9·40	7·23	0·3	0·03	0·03	0·02	21·00
Circle 11 .	293	99	19·52	86·57	12·78	10·74	207	64	16·89	78·53	9·53	7·36	4·5	0·42	0·48	0·33	41·40
Circle 12 .	61	18	19·44	86·78	12·71	10·62	39	13	17·19	80·27	9·95	7·72	1·0	0·09	0·11	0·08	39·00
Circle 13 .	86	15	18·97	85·03	12·16	9·93	14	3	16·07	78·03	8·96	6·74	0·4	0·04	0·04	0·03	14·00
Circle 14 .	607	207	19·87	86·53	13·04	10·92	493	167	17·38	80·11	10·05	7·90	7·5	0·72	0·82	0·50	44·82
Circle 15 .	114	31	19·10	86·50	12·35	10·23	86	33	16·37	80·66	9·51	7·46	0·4	0·04	0·04	0·03	43·00
Circle 16 .	120	38	19·25	86·02	12·66	10·66	80	24	17·03	80·00	9·81	7·54	1·0	0·09	0·11	0·08	40·00
Circle 17 .	330	81	19·49	85·86	12·67	10·50	170	45	16·83	79·03	9·58	7·40	4·2	0·39	0·44	0·31	34·00
Circle 18 .	394	128	19·53	86·14	12·72	10·57	206	73	16·85	79·57	9·64	7·48	4·2	0·40	0·44	0·31	34·33
Circle 19 .	66	13	19·43	85·04	12·64	10·50	34	7	17·33	80·49	10·03	7·86	2·0	0·19	0·21	0·16	34·00
Circle 20 .	147	58	19·46	85·94	12·64	10·40	53	24	17·06	79·71	9·80	7·63	1·0	0·10	0·10	0·08	26·50

SCHEDULE III—*contd*

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No of stalks
	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 21	121	34	19 53	86 20	12 74	10 58	79	24	17 10	79 44	9 78	7 64	1 1	0 10	0 12	0 08	38 50
Circle 22	134	28	19 61	86 01	12 75	10 61	66	16	17 30	80 40	10 03	7 81	0 5	0 05	0 05	04	33 00
Circle 23	60	18	19 47	86 28	12 72	10 60	40	12	17 06	79 77	9 80	7 72	0 5	0 05	0 05	0 04	40 00
Circle 24	89	25	19 33	85 90	12 57	10 19	111	27	17 38	80 29	10 29	7 85	1 0	0 09	0 10	0 08	55 50
Circle 25	127	42	19 62	86 14	12 79	10 70	73	26	15 66	78 07	8 60	6 79	2 5	0 23	0 27	0 17	36 50
Circle 26	314	123	19 28	86 00	12 53	10 48	156	64	16 56	78 96	9 57	7 42	4 6	0 43	0 48	0 34	37 20
Circle 27	67	29	19 60	86 17	12 80	10 69	33	14	17 03	79 74	9 80	7 67	1 0	0 10	0 11	0 08	33 00
Circle 28	68	18	19 16	85 22	12 40	10 22	32	6	16 96	75 50	9 73	7 56	0 6	0 06	0·06	0 04	32 00
Totals and averages	7299	2384	19 54	86 17	12 75	10 64	4201	1404	17 06	79 61	9 79	7 61	100 0	9 52	10 66	7·61	36 53

Factory Results.—
Cane crushed during February . . . . 5,15 188 maunds
Sugar made during February . . . . 48 891 maunds
Yield of sugar per cent cane . . . . . 9·49 per cent

Borer Survey.—
Yield of sugar from mixed cane . . . . 9 52 per cent
Yield of sugar from sound cane . . . . 10 66 per cent
Yield of sugar from infested cane . . . 7 61 per cent

Loss of sugar due to borer infestation and disease 5,15,188 × (10 66—9 52)/100 = 5,873 maunds

SCHEDULE IV

Factory No. 4

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	1305	503	20·12	90·79	13·88	12·10	995	416	17·42	81·12	10·26	8·48	30·7	3·21	3·71	2·60	43·26
Circle 2 .	1295	540	19·98	89·92	14·00	12·23	1005	431	18·00	81·94	10·74	8·59	26·5	2·81	3·24	2·28	43·70
Circle 3 .	1400	582	21·41	90·84	14·07	12·89	991	383	17·33	79·39	9·92	7·75	31·2	3·39	4·02	2·42	41·29
Circle 4 .	434	181	20·83	86·79	13·72	11·59	366	155	17·90	76·10	9·89	7·47	11·6	1·13	1·34	0·87	45·75
Totals and Averages.	4443	1806	20·56	90·14	14·25	12·34	3357	1385	17·66	80·43	10·27	8·20	100·0	10·54	12·31	8·17	43·04

Factory Results:—

Cane crushed during February . . . . . 5,15,563 maunds
Sugar made during February . . . . . 54,761 maunds
Yield of sugar per cent cane . . . . . 10·62 per cent

Borer Survey:—

Yield of sugar from mixed cane . . . . 10·54 per cent
Yield of sugar from sound cane . . . . 12·31 per cent
Yield of sugar from infested cane . . 8·17 per cent

Loss of sugar due to borer infestation and disease 5,15,563 × (12·31 × 10·54)/100 9,125 maunds.

SCHEDULE V

Factory No 5

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No of stalks
	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1	1199	560	20 75	85 02	13 96	12 25	801	406	18 05	81 25	11 18	9 39	19 59	2 16	2 40	1 84	40 05
Circle 2	936	419	20 94	85 17	14 09	11 99	764	373	18 28	80 63	11 23	9 44	25 63	2 77	3 07	2 42	44 94
Circle 3	1038	500	20 90	66 32	14 06	12 33	862	421	19 01	80 50	11 04	9 01	27 63	2 98	3 41	2 49	45 37
Cirlce 4	1009	506	20 65	84 97	13 84	12 03	691	354	17 90	80 22	10 87	9 11	13 79	1 49	1 66	1 26	40 64
Circle 5	1234	582	21 34	85 04	14 05	12 26	916	477	19 58	79 10	11 59	9 44	13 36	1 47	1 64	1 26	41 64
Totals and Averages	5466	2567	20 92	85 29	14 00	12 18	4034	2031	18 62	80 30	11 20	9 28	100 00	10 87	12 18	9 27	42 46

Factory Results —
Cane crushed during February 5 95 039 maunds
Sugar made during February 64,145 maunds
Yield of sugar per cent cane 10 78 per cent

Borer Survey —
Yield of sugar from mixed cane 10 87 per cent
Yield of sugar from sound cane 12 18 per cent
Yield of sugar from infested cane 9 27 per cent

Loss of sugar due to borer infestation and disease 5 95 039 × (12 18—10 87)/100 = 7 795 maunds

SCHEDULE VI

Factory No. 6

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar Per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	2123	1018	20·22	85·03	13·57	11·36	677	318	18·25	79·83	11·06	9·09	35·80	3·89	4·08	3·26	24·18
Circle 2 .	1066	433	19·19	81·60	12·38	10·34	734	281	15·82	73·04	8·86	6·73	2·52	0·22	0·26	0·17	40·78
Circle 3 .	1744	797	19·80	85·21	13·31	11·13	656	290	16·84	77·11	9·83	8·12	15·70	1·62	1·75	1·27	27·33
Circle 4 .	1505	707	19·28	84·47	13·37	11·38	795	378	16·91	78·81	10·12	8·17	4·26	0·44	0·48	0·35	34·57
Circle 5 .	1577	733	19·85	84·93	13·32	11·31	623	270	17·53	78·35	10·45	8·39	9·27	0·97	1·05	0·78	28·32
Circle 6 .	1003	441	19·05	84·13	13·26	11·26	597	247	17·47	78·46	10·44	8·40	2·11	0·21	0·24	0·18	37·31
Circle 7 .	933	408	19·80	82·64	12·98	10·81	367	150	17·03	75·67	9·76	8·12	13·82	1·39	1·49	1·12	28·23
Circle 8 .	1423	595	19·69	84·14	13·09	11·12	977	304	17·18	77·03	10·08	8·05	2·61	0·26	0·29	0·21	40·71
Circle 9 .	980	418	20·00	84·89	13·41	11·27	420	169	17·16	75·06	9·85	8·02	13·82	1·43	1·56	1·11	30·00
Totals and Averages.	12354	5583	19·70	84·47	13·25	11·24	5846	2500	17·14	77·35	10·09	8·13	100·00	10·43	11·20	8·45	32·12

Factory Results :—
Cane crushed during February . . . . . 5,03,377 maunds
Sugar made during February . . . . . 51,924 maunds
Yield of sugar per cent cane . . . . . 10·32 per cent

Borer Survey :—
Yield of sugar from mixed cane . . . . 10·43 per cent
Yield of sugar from sound cane . . . . 11·20 per cent
Yield of sugar from infested cane . . . . 8·45 per cent

Loss of sugar due to borer infestation and disease 5,03,377 × (11·20—10·43)/100 = 3,876 maunds

SCHEDULE VII

Factory No 7

Area	Sound cane: No of stalks	Sound cane: Weight in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No of stalks	Infested cane: Weight in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No of stalks
Circle 1	675	280	20 79	88 30	14 01	11 80	520	12	18 71	81 18	11 46	9 30	10 0	1 16	1 29	1 01	43 52
Circle 2	850	320	20 95	87 43	13 90	11 70	655	249	19 35	84 36	11 86	9 70	7 6	0 81	0 89	0 74	43 35
Circle 3	737	323	20 97	88 94	14 80	12 68	436	184	20 00	85 83	12 80	10 47	20 5	2 44	2 60	2 15	37 17
Circle 4	751	282	21 09	88 33	14 13	12 04	404	167	18 96	84 62	11 64	9 60	11 0	1 21	1 32	1 06	34 98
Circle 5	732	303	20 81	86 81	13 68	11 53	456	191	19 81	79 15	11 37	10 01	11 3	1 23	1 30	1 13	38 38
Circle 6	1012	403	21 15	88 45	14 17	12 02	703	318	19 19	83 21	11 54	9 60	13 8	1 50	1 66	1 32	40 00
Circle 7	234	126	20 95	84 67	13 44	11 04	395	186	17 58	79 49	10 06	7 72	7 3	0 66	0 81	0 56	62 80
Circle 8	733	291	20 98	87 10	14 43	12 23	493	216	19 80	84 51	11 83	9 68	8 2	0 91	1 00	0 79	40 21
Circle 9	475	269	21 05	86 80	13 91	11 37	598	330	19 34	82 62	11 58	9 76	3 3	0 34	0 38	0 32	55 73
Circle 10	534	236	21 16	86 57	14 06	11 83	381	187	19 81	83 45	12 02	9 70	3 3	0 36	0 39	0 32	41 64
Circle 11	618	267	21 42	88 95	14 44	12 23	473	198	18 78	85 02	11 60	9 45	2 8	0 31	0 34	0 26	43 36
Totals and Averages	7357	3100	21 03	87 69	14 13	11 92	5514	2433	19 18	83 04	11 60	9 56	100 0	10 93	11 98	9 66	42 84

Factory Results —
Cane crushed during February 5 56 248 maunds
Sugar made during February 59 377 maunds
Yield of sugar per cent cane 10 67 per cent

Borer Survey —
Yield of sugar from mixed cane 10 93 per cent
Yield of sugar from sound cane 11 98 per cent
Yield of sugar from infested cane 9 66 per cent

Loss of sugar due to borer infestation and disease 5 56 248 × (11 98—10 93)/100 = 5 841 maunds

SCHEDULE VIII

Factory No. 8

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	yield					
Circle 1 .	901	433	20·36	87·94	13·59	11·59	199	72	18·82	86·26	11·81	9·74	30·12	3·42	3·40	2·93	18·09
Circle 2 .	906	422	20·44	88·12	13·67	11·68	194	69	18·81	86·71	11·87	9·99	23·96	2·74	2·80	2·39	17·64
Circle 3 .	734	362	20·23	87·69	13·46	11·46	166	50	18·42	85·98	11·51	9·64	10·24	2·15	2·20	1·85	18·44
Circle 4 .	887	147	20·29	87·93	13·55	11·57	213	80	18·34	86·51	11·86	9·97	4·02	0·45	0·47	0·40	19·36
Circle 5 .	918	418	20·30	87·79	13·50	11·49	182	68	18·91	86·33	11·88	9·98	3·51	0·39	0·40	0·35	16·55
Circle 6 .	660	304	20·15	87·07	13·54	11·55	140	52	19·00	86·70	11·98	10·11	7·05	0·86	0·88	0·77	17·50
Circle 7 .	730	335	20·55	87·59	13·67	11·63	170	60	18·99	86·10	11·89	9·97	9·54	1·08	1·11	0·95	18·89
Circle 8 .	700	369	20·24	87·98	13·51	11·55	200	80	18·61	86·03	11·72	9·89	1·96	0·22	0·23	0·19	22·22
Totals and Averages.	6436	3120	20·32	87·88	13·56	11·57	1464	537	18·80	86·42	11·82	9·91	100·00	11·31	11·58	9·83	18·53

Factory Results:—

Cane crushed during February . . . . 4,70,693 maunds
Sugar made during February . . . . 53,027 maunds
Yield of sugar per cent cane . . . . 11·26 per cent

Borer Survey:—

Yield of sugar from mixed cane . . . 11·31 per cent
Yield of sugar from sound cane . . . . 11·58 per cent
Yield of sugar from infested cane . . . . 9·83 per cent

Loss of sugar due to borer infestation and disease 4,70,693 × (11·58—11·31)/100 = 1,271 maunds

SCHEDULE IX

Factory No 9

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No of stalks
	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1	418	184	20 06	88 09	13 27	11 °9	132	63	18 19	80 09	10 56	8 52	6 4	0 68	0 72	0 55	24 00
Circle 2	454	229	20 03	88 07	13 31	11 32	96	52	18 30	81 62	10 86	8 83	15 1	1 64	1 71	1 33	17 45
Circle 3	319	159	19 87	88 46	13 08	11 02	81	34	18 37	80 74	10 67	8 62	11 7	1 25	1 30	1 01	20 °5
Circle 4	347	161	°0 35	8‑ 89	13 28	11 31	53	24	19 16	81 56	11 40	9 38	2 3	0 25	0 26	0 2°	13 25
Circle 5	158	83	°0 21	89 48	13 45	11 43	42	°0	18 98	81 58	11 24	9 23	4 7	0 52	0 54	0 43	21 00
Circle 6	239	132	20 01	88 96	13 2°	11 24	61	32	19 33	84 11	11 96	9 93	2 9	0 32	0 33	0 29	17 43
Circle 7	498	252	19 82	88 24	12 95	10 99	102	31	19 23	83 40	11 63	9 59	6 7	0 72	0 ‑4	0 64	17 00
Circle 8	571	331	19 93	87 61	12 94	10 95	129	65	18 89	80 51	11 11	9 05	16 3	1 75	1 ‑8	1 48	18 43
Circle 9	576	°89	19 91	88 08	13 00	11 12	124	59	18 69	81 88	11 14	9 10	7 7	0 83	0 86	0 ‑0	17 71
Circle 10	‚04	°45	19 34	87 85	12 31	10 34	96	49	18 80	82 33	11 3°	9 23	9 5	0 96	0 98	0 88	16 00
Circle 11	80	42	19 69	89 43	13 07	11 13	0	31	18 77	84 85	11 57	9 52	10 9	1 14	1 21	1 04	46 67
Circle 12	399	185	19 47	89 37	12 91	10 95	151	79	17 52	81 84	10 35	8 31	5 8	0 59	0 64	0 48	27 45
Totals and Averages	4613	229°	19 87	88 25	13 01	11 05	1137	539	18 54	81 78	11 03	8 99	100 00	10 65	11 07	9 05	19 77

Factory Results —

Cane crushed during February	4 68 564 maunds
Sugar made during February	49,941 maunds
Yield of sugar per cent cane	10 66 per cent

Borer Survey —

Yield of sugar from mixed cane	10 65 per cent
Yield of sugar from sound cane	11 07 per cent
Yield of sugar from infested cane	9 05 per cent

Loss of sugar due to borer infestation and disease 4 68 564 × (11 07—10 65)/100 = 1 968 maunds

SCHEDULE X

Factory No. 10

Area	Sound cane: No. of stalks	Sound cane: Weight in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No. of stalks	Infested cane: Weight in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
Circle 1	433	157	20·12	87·05	13·72	11·61	197	70	18·13	83·62	11·52	9·36	5·13	0·57	0·60	0·48	31·27
Circle 2	414	140	19·78	87·89	13·73	11·70	176	68	18·18	83·19	11·50	9·28	2·87	0·32	0·34	0·27	29·83
Circle 3	409	156	19·75	88·28	13·74	11·72	182	53	18·35	84·55	11·24	9·01	7·36	0·81	0·86	0·66	27·96
Circle 4	479	165	19·81	87·60	13·71	11·68	144	53	18·35	82·32	11·50	9·25	5·14	0·57	0·60	0·48	23·11
Circle 5	399	198	20·30	87·74	14·06	11·89	213	89	18·20	81·27	11·27	8·93	7·64	0·82	0·91	0·68	34·80
Circle 6	404	192	19·93	87·31	13·96	11·85	210	91	18·32	79·87	11·16	8·70	5·15	0·55	0·61	0·45	34·20
Circle 7	304	166	20·25	86·65	13·85	11·66	252	121	18·03	81·97	11·24	8·98	4·94	0·61	0·58	0·44	40·01
Circle 8	308	131	20·21	87·04	13·90	11·73	106	51	19·20	84·21	12·29	10·03	2·64	0·30	0·31	0·26	25·61
Circle 9	549	239	19·86	88·36	13·29	11·33	166	73	18·61	83·24	11·25	9·04	6·09	0·66	0·69	0·55	23·22
Circle 10	476	217	20·25	87·68	13·48	11·51	230	102	18·57	85·13	12·02	10·02	5·74	0·63	0·66	0·58	32·58
Circle 11	488	199	19·87	87·01	13·80	11·77	248	130	17·92	83·40	11·36	9·24	7·17	0·70	0·84	0·66	33·70
Circle 12	491	300	19·80	87·88	13·98	11·96	201	96	18·67	85·20	12·09	10·04	4·01	0·46	0·50	0·40	20·05
Circle 13	547	210	20·11	88·12	13·99	11·98	169	62	18·62	85·02	12·05	9·98	4·63	0·54	0·55	0·46	23·60
Circle 14	494	215	20·27	87·93	14·11	12·07	223	104	19·22	83·22	12·14	9·81	4·91	0·56	0·59	0·48	31·10
Circle 15	493	156	20·81	87·73	13·85	11·63	191	76	19·56	82·19	11·67	9·10	9·92	1·07	1·15	0·90	27·92
Circle 16	428	162	20·08	86·46	13·52	11·20	265	99	19·05	83·10	11·40	9·20	16·69	1·74	1·87	1·54	38·24
Totals and Averages.	7236	3018	20·09	87·66	13·80	11·72	3173	1338	18·53	83·15	11·60	9·36	100·00	10·90	11·66	9·29	30·48

Factory Results:—

Cane crushed during February	4,01,191 maunds
Sugar made during February	52,593 maunds
Yield of sugar per cent cane	10·71 per cent

Loss of sugar due to borer infestation and disease 4,01,191 × (11·66—10·90)/10 = 3,733 maunds

Borer Survey:—

Yield of sugar from sound cane . . .	11·66 per cent
Yield of sugar from mixed cane . . .	10·90 per cent
Yield of sugar from infested cane	9·29 per cent

SCHEDULE XI

	Factory No 1		Factory No 2		Factory No 3		Factory No 4		Factory No 5		Totals and averages	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Total number of stalks examined .	5,300	10,390	8,500	13,100	4,500	11,500	3,400	7,800	2,150	9,500	23,850	52,290
Total No of infested stalks	2,580	4,434	2 941	4 235	1,567	4,201	1,903	3,357	865	4,034	9,856	20,261
Degree of infestation	48 68	42 68	34 60	32 33	34 80	36 53	55 97	43 04	40 00	42 46	41·32	38 75
Weight in cers per 2,000 stalks (sound)	778	676	662	548	836	654	986	814	1,092	940	797	699
Weight in seers per 2 000 stalks (infested)	837	721	668	546	839	668	950	825	1,080	1,007	830	748
Purity of extracted juice (sound cane) .	86 34	85 85	83 59	84 25	86 77	87 17	86 45	90·14	85 78	85·29	85·74	86 43
Purity of extracted juice (infested cane)	81 08	80 35	78 35	79 26	78 94	79 61	74 91	80 43	81 11	80 30	79 01	79 99
Sugar per cent sound cane	13 23	13 20	12 68	13 04	12 76	12 75	13 27	14 25	13 07	14 00	13 00	13 45
Sugar per cent infested cane	10 84	10 80	10 12	10 30	9 23	9 79	8 22	10·27	10·11	11 20	9 76	10 50
Estimated sugar yield from sound cane	11 27	11 42	10 57	10 81	10 76	10 66	11·23	12 31	11 52	12 18	11 08	11 48
Estimated sugar yield from infested cane	8 96	8 93	8 05	8 22	6 98	7 61	6·16	8 17	8 30	9 27	7·76	8·47
Estimated sugar yield from mixed cane	10 13	10 35	9 76	10 02	9 38	9 52	8 48	10 54	10 15	10 87	9 62	10 27
Actual factory yield of sugar . .	10 05	10 25	9 68	10 01	9 56	9 49	8 64	10·62	10·10	10 78	9 64	10 24
Maunds cane crushed . .	5 88,537	5,71,581	5,85,136	5 84,710	5,02,596	5,15,188	5,10,920	5,15,563	6,13,251	5,95,039	28 00,440	27,82 081
Maunds sugar lost due to infested cane	6,709	6,116	4,740	4,619	6,936	5,873	14,053	9,125	8 401	7,795	40 839	33,528

Schedule XII

	Factory No. 6		Factory No. 7		Factory No. 8		Factory No. 9		Factory No. 10		Totals and averages	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Total number of stalks examined	7,168	18,200	1,980	12,871	2,700	7,900	1,800	5,750	2,673	10,400	16,221	55,094
Total No. of infested stalks	2,230	5,816	904	5,514	408	1,464	437	1,137	676	3,173	4,715	17,134
Degree of infestation	31·11	32·12	15·60	42·84	17·33	18·53	24·28	19·77	26·27	30·48	29·09	31·10
Weight in seers per 2,000 stalks (sound)	972	902	828	844	984	970	1,308	992	1,210	834	1,040	900
Weight in seers per 2,000 stalks (infested)	922	857	846	882	800	734	1,198	984	1,112	813	919	858
Purity of extracted juice (sound cane)	87·22	84·17	87·75	87·69	87·29	87·88	89·45	88·25	85·96	87·66	87·57	87·17
Purity of extracted juice (infested cane)	80·48	77·35	81·38	83·04	84·63	86·42	81·10	81·78	84·00	83·15	82·81	82·31
Sugar per cent sound cane	12·94	13·25	12·88	14·13	12·70	13·56	13·34	13·01	12·92	13·80	12·97	13·57
Sugar per cent infested cane	9·78	10·09	10·74	11·60	10·46	11·82	10·12	11·03	11·43	11·60	10·50	11·23
Estimated yield from sound cane	10·84	11·20	10·84	11·98	10·74	11·58	11·39	11·07	10·83	11·66	10·93	11·51
Estimated yield from infested cane	7·65	8·45	8·56	9·66	8·60	9·83	8·13	9·05	9·37	9·29	8·45	9·26
Estimated yield from mixed cane	9·86	10·43	9·67	10·93	10·47	11·31	10·62	10·65	10·47	10·90	10·19	10·84
Actual factory yield of sugar	9·67	10·32	9·81	10·67	10·63	11·26	10·49	10·66	10·50	10·71	10·18	10·72
Maunds cane crushed	5,13,803	5,03,377	5,06,258	5,56,218	4,28,518	4,70,693	5,04,128	4,08,564	4,74,300	4,01,101	25,17,016	24,00,073
Maunds sugar lost due to infested cane	5,035	3,876	6,738	5,841	1,157	1,271	3,882	1,968	1,708	3,733	18,520	16,689

THE PROBLEM OF ANIMAL NUTRITION IN INDIA*

BY

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AND

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Introduction

The unique place which human nutrition occupies in relation to preventive medicine and public health is also the legitimate position which animal nutrition should occupy in relation to veterinary science and animal husbandry While the importance of the former combination has been recognised, the significance of the latter has so far attracted but little attention in India

It is obvious that in any sound scheme of human economy, the animal must play a predominant part It provides man with his food, clothing and power for tillage and locomotion While it may be possible for advanced Western countries to replace the animal's wool by artificial fibre and its labour on the road and the field by suitable motor tractors, all that many years of mechanization can do in India is barely to replace it as a means of locomotion

To comprehend the immensity of the problem it is necessary to understand that the cattle population in India including buffaloes, is about 57 per cent of the human, while inclusive of the other domestic animals such as sheep, goats, horses, etc , it amounts to about 85 per cent of the human population On the credit side of the activities of this animal population are (*a*) the export trade of India which consists mainly of agricultural products such as jute, rice, wheat, cotton, and oil seeds, (*b*) the food crops consumed by the human population, (*c*) milk and milk products yielded by them, (*d*) wool produced by sheep, however small the yield may be, (*e*) beef, mutton and goat's meat which go into the human dietary, (*f*) hides

*This is the eleventh of a series of popular articles for practical farmers on various animal husbandry subjects of general interest

and skins which form an important export of India and (*g*) the return to the land of a good part of the feed in the shape of valuable manure. The animals receive in exchange the crop stubbles from cultivated areas, the aftermaths on these fields in the shape of weeds or other plants, the grasses on field borders or along water-courses and the uncultivated scarce pasturage of poor quality on the natural grazing lands near villages. The feeding of concentrates is practised by so few cattle-owners as to be almost negligible.

Such balancing of the public health and national prosperity of India on the slender back, or perhaps more appropriately on the half-fed stomach, of its mercilessly exploited cattle population has the appearance of the impossible. The fact that the burden is carried does not indicate competence to do so on its part. The inadequacy of feeding and care is too apparent to allow of any such conclusion.

An attempt is made in this paper to consider a proper scheme for the nutrition of our animal population with special reference to farm-stock, so that the keeping of a good stock of animals in optimum health might enable our national health and wealth to rest on surer foundations.

Fodder resources of India. The question of supply and demand

The adequate nutrition of an animal involves the provision of a sufficiency of the three proximate principles, protein, fats and carbohydrates. Water and salts form an equally necessary requirement. This is not to presuppose that the other accessory constituents of food such as the vitamins, amides, lecithins, cholesterol or the lipochrome pigments are unessential. It is established that all these constituents of food are necessary for the proper nutrition of animals and that an excess of any one, or any groups of these substances will not compensate for the entire absence of any of the others, however microscopic the requirement of the animal for that particular ingredient may be.

The roughage feed of animals is important in more than one way. It supplies animals with the energy required to carry on the vital processes of life and enables them to maintain body temperature, besides providing the energy requirements for work and milk production. Being a bulky food it gives the animal a feeling of fulness after a meal. The large quantities of cellulose and other indigestible material in it help to promote proper peristaltic movements. Further, the excess amounts of the digestible carbohydrates are stored by the animal system as fats, which form its main source of reserve energy in times of need. The provision of a sufficiency of carbohydrates, however, seems at first sight to be an easy matter, since the bulk of all plant material consists of these substances.

According to recent census figures there are in the whole of India 201 million head of cattle alone. Allowing a maintenance requirement of 10-12 lbs. of dry matter per head per day, the average requirement of the cattle population of this country is in the neighbourhood of 365 million tons of fodder (dry matter) per

annum To set off against this demand we have at present a net cultivated area of 300 million acres, 60 million acres of current fallow, and making allowance for all other accessible sources of cattle fodder, an additional 170 million acres of cultivable waste These together make an aggregate of 530 million acres from which our cattle obtain under maximum exertion from man and beast, their wherewithal to maintain themselves Now, Western estimates of the yield of hay or straw from natural grazing lands approximate to one ton of dry matter per acre Indian estimates of the straw and other herbages available from cultivated lands put it at about thirty maunds per acre which is also a little over one ton per acre This is to say that to meet the demand for 365 million tons of fodder, there is an available source of 530 million tons This represents a fifty per cent excess over the maintenance requirement of our cattle population

Two important factors have to be reckoned with in this connection One is the fact that the maintenance allowance of ten to twelve lbs of dry fodder per head of cattle does not include the energy involved either in the yield of milk by cows or in the output of work by the working animals Milch animals and animals at work are known to consume two or more times the quantity of feed which an animal at rest would require The other important fact is that, in the above computation of the animal requirements of fodder, no account has been taken of the fodder supply necessary for our other domestic animals such as sheep, goats, horses and camels Excluding pigs and poultry, their population amounts to nearly 100 million head The above considerations show that the situation regarding the supply of bare roughage for our animal population, irrespective of its quality is so deficient in quantity that it does not justify neglect of the problem of animal nutrition in this coutnry

Protein deficiency in Indian roughages

Assuming it possible by suitable land husbandry to secure animals against this state of semi starvation, is the available fodder good enough to fulfil their requirements for other constituents of food ? A sufficiency of protein in the feed of an animal is an indispensable factor It supplies the necessary material for building up the body and to repair the basal catabolic wastage of the body tissues day by day As a result of numerous experiments conducted at the Animal Nutrition Section, Izatnagar, it has been estimated that a 1,000 lb bullock at rest would require about 180 grms of digestible crude protein per day to maintain itself in nitrogen equilibrium On the basis of a 600 lb body weight for an average animal it requires about 108 grms of digestible crude protein for mere maintenance purposes As has been already stated, the fodder available to cattle in this country mainly consists of the cereal straws and stubbles, and the dried herbages which remain on cultivated lands after harvest, and also the over ripe dried grasses which pass as hay Some of these grasses, cut at the proper stages and cured into hay, are quite good as cattle fodder, their protein content in tender cuttings being

as high as 18 per cent. Under the present practical conditions of cattle feeding obtaining in this country, their crude protein content is less than about 3 per cent and their digestible protein content often lower than in cereal straws. In most cases, the dry roughage available can be assumed, for purposes of nutritive value, to contain no significant amount of digestible crude protein. In any case, the ten to twelve lbs. of straw or hay, that may be available for the average cattle by improving the sources of supply, cannot supply more than 0·06 lbs. of digestible crude protein, whilst the animal needs four or more times that amount. No account has yet been taken of the protein requirements of young stock for their growth and of milch animals for milk production. Foreign estimates provide a maintenance ration of 0·6 lbs. of digestible crude protein and another equal quantity for the production of 10 lbs. of milk. Thus, the protein provided for the average animal in India is less than its requirement for simple maintenance, excluding the extra amounts required for flesh formation and milk production.

Mineral requirements

Having considered the energy and protein requirements of animals, it is natural that the supply of their skeletal substances is also assessed. It is known that 90 per cent of the skeleton of animals is made up of lime and phosphorus. While an excess of these mineral constituents is deposited in the bones, the skeleton is depleted of its lime and phosphorus if the animal's feed is deficient in these ingredients. Such a depletion is known to produce porosity and brittleness of bone. The need of growing animals for these minerals is more than that of adults, while the requirement of milking animals is considerably greater. It has been estimated, both in India and foreign countries, that the minimum requirement of a 750-lbs. animal would be about fifteen grms. of lime and ten grms. of phosphoric acid per day. Normally, the cereal straws are not poor in these minerals, but those grown on certain acidic soils may suffer from a minor deficiency. A lime content of 0·3 per cent in the fodder will supply the minimum requirements of lime if the animals consume about ten to twelve lbs. of roughage per day. But the same fodder may just fail to contain the optimum quantity of phosphoric acid, which imbalance will upset the proper assimilation of both the minerals. Deficiency of minerals in the feed of animals and their reaction on their normal health and production have been extensively studied in farm animals. It has been observed that most fodders and good pastures contain considerable quantities of minerals and that they are duly balanced in regard to all minerals. Emphasis has, however, been laid on the lime/phosphorus ratio. For best assimilation a ratio of 1·3—1·5 of lime to 1 of phosphoric acid has been found to be most suited, an excess of phosphorus resulting in the wastage of both. When the quantities present in the feed are abnormal the ratio is not significant. It has been found that with minimal quantities of lime and phosphorus an associated deficiency of vitamin-D will produce rickets in some animals and a low phosphorus intake produces a disease,

osteomalacia in bovines Mention should also be made that the conditions favourable to their utilization diminish with the advancing maturity of the crops From the foregoing it may be concluded that while the chances of direct acalcicosis are few, there is always the likelihood of an indirect disturbance to the lime and phosphorus metabolism

So far we have discussed the inadequacy of the feeding available to our live stock from the standpoint of the major ingredients in their foodstuffs It has already been stated that there are very small quantities of substances, mineral as well as organic, which play their own important roles in the proper nutrition of animals Our knowledge regarding the occurrence, nature and necessity as also the utilisation and quantitative requirements of these small factors by animals is so uncertain in regard to Indian conditions, that no attempt can be made in this article to relate these to the entire animal population of this country Their necessity and importance to cattle have however, been demonstrated by clinical conditions that result from a deficiency of these substances in their dietary, either partial or complete single or combined The radical change in outlook which nutritional studies have undergone as the outcome of these qualitative factors makes it necessary that these conditions are considered in regard to the proper nutrition of cattle in India On mineral ingredients, considerable amount of work has been done A lack of iodine in the diet is found to be the cause of goitre and the 'hairless pig malady" An iron deficiency in the food results in primary anaemia Copper, manganese and other rare elements in cattle fodder have also been studied, but so far no definite information is available on specific deficiency diseases attributable to them

THE VITAMIN PROBLEM IN ANIMAL NUTRITION

The role of vitamins has been more intensively studied with reference to human dietary than with regard to feeding live stock Recent work on deficiency diseases due to absence of vitamins in diet has shown that unnoticeable shortages of these valuable substances may also result in complicated diseases It has been pointed out that a vitamin A deficiency in the food can cause a retardation of growth, eye diseases from mild ophthalmias to atrophy of the eyeballs and loss of lenses, lung diseases kidney and other stone deposits Severe diarrhoea in calves, ophthalmia in growing animals and premature expulsion of foetus or birth of dead or weak calves with nervous disorders have been observed in cattle due to vitamin A deficiency Closely associated, in solution in the fats of green young plant material, is the substance known as vitamin D, which plays an important part in the metabolism of bones and various disorders connected with the skeletal tissues Reproduction is closely linked with the presence of vitamin E which again is fat soluble Lack of this vitamin is known to cause a degeneration of the germ cells in the testes of the male, while in the female foetuses are resorbed Some unsaturated fatty acids, such as linoleic acid, have also been found essential for the

prevention of a certain deficiency disease, akin to pellagra. These acids go under the name vitamin-F. Incidentally, the importance of the fat in the feed of farm-stock becomes more apparent as the carrier of these valuable accessory substances.

Of the other vitamins, vitamin-B, has been found to be necessary for the prevention and cure of polyneuritis, loss of appetite and gastro-intestinal troubles. This vitamin is, however, known to be synthesized in the cattle system and hence it is not so essential as the others. Vitamin-B_2 or G as it is also called, is known by the dermatitis, mouth lesions and cataract formation that result from its absence in the dietary. Loss of reflexes also develops if the deficiency is prolonged. Vitamin-C, the principle present in fresh fruits, vegetables and leaves, is identified by the diseases produced by its absence from the food, such as sore gums and joints, loose teeth and eventually capillary haemorrhages. The list of vitamins is, however, continuously expanding, lending support to the view that the last word has not yet been said on the factors that determine the nutritional health of an animal.

It may generally be said that the liability of farm-stock, under natural conditions, to diseases due to the complete absence of any of these vitamins is less than in the case of human or other animals. All ruminants subsist, at least for a small part of the year, on fresh green pasture which generally provides an excess of these constituents. It is, however, possible in many cases that the supply or the reserve falls short of the optimum and yet enables the animal to carry on under minor degrees of malnutrition.

Nutrition in relation to intensive production

There is another aspect of the problem of nutrition among the cattle of this country which has not yet been touched upon. With the changed circumstances in Indian life, there has been a progressive exodus of the human population from the villages to the cities of India, mostly in pursuit of occupation. It is but natural that the concentration of the human population in cities must bring about a similar concentration of the necessary auxiliary animal population, chiefly milch animals. The average Indian is quite aware of the value or utility of cows' milk for the proper nutrition of human beings. If the average consumption of milk and milk products in India is much lower than in other countries, it has to be attributed to two limiting factors, (*i*) the poor capacity for production of our cows which raises the prices of these commodities and (*ii*) the poorer purchasing capacity of the average Indian. The average city dweller's capacity to purchase either milk or other necessities of life is decidedly higher than that of an average villager. The exodus of a large number of milch cattle to cities to meet this demand for dairy produce has been responsible for the development of what may be called dairies in and around these cities. The problem of nutrition so far considered by us related only to animals kept by the individual householder, who has no idea of making his cow or she-buffalo an economic proposition, since their products are mainly

intended for home consumption The case would be a little different in villages situated within easy reach of a town It is a fact that the problems in respect of keeping a number of milch animals as a business organization and their proper care and feeding have arisen only with the rapid growth of cities

The intensive stock keeper s problems are somewhat different It has been estimated that the consumption of milk in towns such as Bombay, Calcutta and Poona is 7—8 gallons per annum or 3—3½ ounces per day per head of human population About four fifths of the entire milk supplies of these towns comes from animals which are stabled within the city It can be assumed that these animals lose all the benefits of a natural life in the open The stall feeding of cattle under the insanitary conditions obtaining in large towns (particularly with the object of forcing the animals to intensive production), often results in diseases attributable to nutritional and metabolic disorders

If dairy animals are fed on cultivated pasture crops there is no likelihood of any mineral deficiency For instance, cows' milk has been known to contain 2 38 grms of CaO and 3 43 grms of P_2O_5 per 1000 calories, while highly manured pasture contained 9 13 grms of CaO and 3 68 grms of P_2O_5 But the problem of deficiency must arise where roughage of poor quality has to be supplemented by cereals and oil cakes for forcing greater production As a matter of fact the excess concentrate feeding by a temporary stimulus to growth, is often likely to mask this deficiency in the diet While the occurrence of rickets and osteomalacia is attributable to a deficiency of calcium and phosphorus in the diet of animals, it is quite probable that the conditions known as acetonaemia and milk fever are also the results of a mineral deficiency The intensive stock keeper thus has to guard against both these nutritional and metabolic disorders

While opinion holds that in farm animals, under natural conditions of grazing where green fodder is available, much anxiety need not be bestowed on diseases due to vitamin deficiencies it also holds that for animals kept in stalls more appropriate to laboratory than to field conditions, the problem assumes considerable importance It cannot be gainsaid that in intensive stock keeping under the conditions obtaining in the cities of India, conditions of rearing are highly artificial With the increased concentrate feeding that is generally resorted to in order to force more and more milk, both the quality of roughage and their consumption by the stall fed animals are likely to be neglected, so that their feeding, though rich, may be unbalanced in several respects

In this connection attention may be paid to the disease called grass tetany, which is charact rised among other symptoms, by nervousness and a subsequent nervous break down akin to epilepsy It is noteworthy that the cattle of orthodox farmers seldom suffer from this disease, yet it occurs in places where improved methods of feeding and manuring are adopted, and is generally observed during

the first two weeks the cows are put on to grazing. Although the etiology of the disease is difficult to define, it is agreed that the excess amount of young and quick growing grass, grown as a result of heavy manuring, which the animal voraciously consumes when freshly put on to it after its winter-rationing on cereals and oil cakes (poor in minerals), are the factors responsible for this disease.

The ideal feed—a balanced diet

Having dealt with the animal requirements of protein, fat, carbohydrate, minerals and vitamins from a forage plant, something has still to be said about the plant. There is still a good deal of material left in the plant which future research may prove to be of high biological value. The mass and variety of interesting information available on these qualitative aspects of nutrition may even induce the belief among stock-feeders that these substances are by themselves capable of stimulating health, growth or production. On the other hand the addition of any of these substances can be of use only in correcting a diet which is deficient in that particular ingredient and can be effective in improving either health, growth or production only to that extent and no more ; further increases in intake being liable to cause positive harm. It cannot be ignored that a balanced ration and a sufficiency of it still remains the ideal, all new additions to our knowledge being helpful in arriving at that ideal. The advantages of an ideally balanced diet would definitely ensure against a deceptive state of apparent health in animals, actually suffering from minor undetectable degrees of malnutrition. Such inhibited conditions would reduce the animal's capacity to resist infective diseases. In an animal under ideal conditions of nutrition, which means health, the susceptibility to infection is counterbalanced by the resistance of the system to infection, so that the animal would become less liable to contract infectious diseases.

Aim of breeders : not numbers—but efficiency

In suggesting ways and means by which our cattle population may be brought nearer the ideal represented by an adequate nutrition, it has to be recognized that the chief requirement of the Indian cultivator is a hardy work animal He must, therefore, regard the cow primarily as the source of his work cattle, and only secondarily as a milk producer. Where there is a large demand for milk and milk products, the buffalo has been mainly responsible for that supply and not the cow.

A comparison of the cattle population including buffaloes reveals the fact that per 100 acres of net area sown, India maintains sixty-seven head of cattle while Egypt has only twenty-five, the general condition of agriculture in the two countries being very similar. These figures may be taken as an index of the efficiency of our cattle for work purposes, especially as a large percentage of the land in Egypt is double-cropped. The efficiency of milk production per head of Indian cattle shows an even worse comparison, the average milk yield of a cow and a she-buffalo being 600 lbs. and 1,200 lbs. per annum respectively. With the rapid increase of human population there is an enhanced demand for food crops as well as

for dairy produce. To meet this demand with our inefficient live stock the cultivator and the dairyman keeps a greater number of animals. It is not realised that if a certain amount of fodder can maintain 100 animals of 1,000 lbs live weight each the same amount of fodder cannot maintain 200 animals of 500 lbs live weight. The result is that the fodder problem is rendered more and more acute. This situation should be arrested by increasing the efficiency of the existing animals instead of increasing their numbers.

Improving the fodder resources by scientific conservation

An important step in increasing the efficiency of our animals is the provision of an adequate food supply. It has been stated earlier that the available coarse fodders in the country are not sufficient to maintain its large animal population. It is also known that most natural grasses when in fresh green condition are of great value in the proper nutrition of cattle. In addition to the existing grazing lands there are extensive areas in India classified as forests and land not available for cultivation. During the monsoon periods of the year these areas grow quite an abundance of good quality fodder. Experiments have shown that scientific preservation of green fodder as silage or as hay results in products which have a high nutritive value in the feeding of cattle. The application of such methods of conservation on a large scale to the excess of green fodder grown during the monsoon periods should make it possible to increase our fodder supply considerably and thus bring about a great improvement in the condition of our animal population.

THE ORGANISATION OF VETERINARY WORK IN GERMANY

BY

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HAVING been sent as a delegate by the Imperial Council of Agricultural Research to the World's Dairy Congress, which was held in Berlin in August 1937, I took the opportunity, with the generous help of our Veterinary colleagues in Germany of seeing something of the organisation which exists in that country for the training of Veterinary students, the control of contagious and communicable diseases and the improvement of live-stock generally.

All these subjects are of the greatest interest to us in India, and in particular I was immensely impressed by the German Veterinary Colleges, for it is difficult to visualize anything more complete than the facilities provided for the training of Veterinary students in Germany.

There are five Veterinary Colleges or High Schools in Germany, *viz.*, Berlin, Leipsig, Hannover, Munich and Geissin, and of these I had the pleasure of visiting the three first named. The course extends to five years in each of them. They are all affiliated with the local University, in which they are given a separate Veterinary faculty, except Hannover, where there is no University. This Institution, therefore, works as a High School and grants its own diplomas, but I was assured that no distinction was drawn between the value of this diploma and that of the other Colleges.

Within each College or High School, the different subjects are grouped together in separate self-contained Institutes, or as we should call them departments, each with its own Director. One of these Directors acts as Rector or Principal of the College, in addition to his other duties. Each of these Institutes is housed in a separate building, and supplied with its own lecture rooms, practical class rooms, museum, library and wards, or other appendages appropriate to the work to be performed.

Although no doubt a certain amount of research work is in progress at all the Colleges, it is only at the Berlin College that special facilities for this are provided. This probably accounts for the fact that the number of separate Institutes

in this College amounts to as many as fourteen while at the other Colleges the number is about ten or twelve A normal grouping of the subjects may be taken as follows —

1 Histology and Anatomy,

2 Physiology including Nutrition,

3 Pharmacology including Materia Medica,

4 Zoology and Parasitology,

5 Pathology,

6 Hygiene and Microbiology,

7 Genetics and Breeding including a Dairy,

8 Large animal Medical Clinic,

9 Large animal Surgical Clinic,

10 Small animal Clinic, and

11 Milk and Food Inspection

Consideration of the above list of subjects will show the comprehensive character of the course at German Veterinary Colleges and the fact that separate Institutes are provided for Animal Nutrition and Animal Genetics emphasizes the stress that is laid on the study of the physiological as well as the pathological side of our subject Moreover the provision of a dairy at each College enables the students to be brought into daily contact with the healthy in addition to the diseased animal

For the prosecution of research into virus diseases, particularly Foot and Mouth disease, and the preparation of suitable biological products for their control a special research station has been set up on the Island of Reims off the north coast of Germany, and a visit to this inevitably reminded one of the Mukteswar Institute in India for the two Institutes have very much in common As communication with the mainland is allowed only by special permit, special arrangements have to be made for housing and feeding the staff, providing them with recreation and disposal of sewage and waste products from the Institute Foot and Mouth disease serum is made on a large scale, the serum makers (Freisian bullocks) being hyperimmunised against Types O A and C of the virus and then bled out and their carcasses dressed and sold for beef Very special arrangements, by which the animal is kept on one side of a wall and the serum collected on the other, had to be devised before a sterile serum could be obtained, but this is now the order of the day The serum is stored in a cool room in large glass

containers and tested periodically for sterility. The serum is not used after two years of storage. The virus is maintained and the serum is titrated in guinea pigs.

Other diseases under study at this research Institute are Swine Influenza and what in Germany is called Infectious Bronchitis of horses. The latter appears to be the same primary condition, caused by a virus, which is met with in Remount Depots and amongst cavalry units in India, and it is suggested that such conditions as Pleuro-Pneumonia, Paddock Fever, etc., are secondary to this, and will not occur if the animals are kept perfectly quiet.

The routine examination and diagnosis of morbid material is divided amongst two classes of Institutes, that from milk, meat and food intended for human consumption is sent to the Institutes of Milk and Food Control at the different Veterinary Colleges, where these are available, and in this connection it may be observed that all food animals in Germany are slaughtered in public slaughter-houses which are administered by the Veterinary Department, which is also responsible for the inspection of other foodstuffs such as fish, eggs and milk, the only exception being the chemical analysis of milk.

Material from animals in the field, suspected to be suffering from certain scheduled conditions, *e.g.*, Tuberculosis, Bang's disease (Contagious Abortion), Sterility, etc., and for the diagnosis of equine pregnancy is dealt with in special Institutes, which have been set up for this purpose in convenient centres. These Institutes also act as the distributors for Foot and Mouth disease serum and other biological products and they undoubtedly play a large part in the good results which are being obtained in the control of the above mentioned conditions. For the diagnosis of cases of Tuberculosis. in which the organisms are not demonstrable in the milk, the examination of sputum from the trachea is relied upon. The use of vaccines in the treatment of bovine contagious abortion is prohibited in Germany, yet by efficient methods of diagnosis and hygienic measures in the sheds, certain areas are already declared to be free of the disease.

Mares which have proved barren for two years in succession are required to be reported to the Veterinary authorities for investigation of the cause and all stud animals have to be certified as fit for breeding purposes by a Veterinary Officer before they are registered.

The head of this official Veterinary Organisation holds a position in the Ministry of the Interior exactly analogous with the head of the Public Health Department, an arrangement which gives Veterinarians in Germany a status which is not found in many other countries.

It must not be thought, however, that Germany relies entirely on her State Veterinary Service for the unique position she holds in the matter of promoting

the health and welfare of her animal population, and indirectly that of her human population also There are numbers of private Veterinary practitioners who are also aiding greatly in this good work and one is at once struck with the amount of valuable material that these men supply to the College laboratories and wards and other Institutes The liaison between them and the more official side of the profession must be very close and altogether it may be said that the Veterinary profession in Germany as a whole is a most efficient organisation and is doing a great deal towards advancing the welfare of the country No doubt the excellent training which all German Veterinary graduates receive during their student days is largely responsible for this

Fig 1 A twig of an affected *ganja* plant—Enlarged

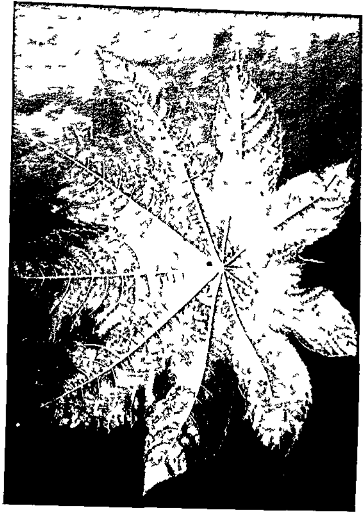

Fig 2 Castor leaf showing attack by *Tetranychus telarius*

MITE (ACARINA) PESTS OF CROPS IN SOUTH INDIA AND METHODS FOR THEIR CONTROL

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Introduction

Mites, eelworms, millipedes, crabs, snails and birds do considerable damage to crops. The paper deals with the mite pests of crops met with in South India. An attempt is made, to note the crops affected, nature of injury, extent of damage, life cycle of the pest and remedial measures.

General description and life-history of mites

Mites belong to the order Acarina of the class Arachnida which also includes ticks, scorpions, spiders, etc. These are eight legged creatures, of small size, and sucking mouth parts. Under Coimbatore conditions, their life cycle does not exceed a fortnight. Although both sexes are present, cases of parthenogenesis are not uncommon. The adults as well as larvae and nymphs feed on the plant sap as a result of which the affected portions of the plant dry up.

Mite pests of crops

Nine species affecting different crops are treated in this paper. These are :

Tetranychus telarius. (Family—Tetranychidae).—This is a well-known mite [Hirst, 1920]; [Cherian, 1932; 1934, 2], and is found on a variety of plants, the more important of which are *ganja* (*Cannabis sativa*), castor (*Ricinus communis*), tomato, (*Lycopersicum esculentum*), Cambodia cotton (*Gossypium hirsutum*), rose (*Rose* spp.) and jasmine (*Jasminum sambac*).

On *ganja* the mites do enormous damage and, in some years, about thirty to fifty per cent of the crop may be affected. They take about nine to twelve days to complete their life cycle. They puncture the leaves and flowers and feed on the sap, the affected portions drying up gradually. In case of severe infestation the attacked portions of plants are found webbed together (Plate XXXIV, Fig. I.) Cakes prepared from such plants are very poor in quality.

In the Madras Presidency, the *ganja* crop is grown only in two centres, *i.e.*, at Santaravur in Guntur district and Hosur in Salem district. The pest is found in

a fairly serious form in both these places In one year, the crop grown in the Central Farm, Coimbatore, for experimental purposes, had to be destroyed due to the attack of this mite

The application of sulphur is generally effective against all kinds of mites But, in the case of *ganja*, some other remedy had to be found out because it was noticed that cakes prepared from plants dusted with flowers of sulphur or sprayed with lime sulphur contained traces of sulphur which produced irritation when smoked Fish oil rosin soap at a strength of one lb in six gallons of water was found effective against the pest and cakes prepared from plants which received this treatment passed the smokers' test successfully

The same mite is also found on castor The plants may be affected during early period but more during late period In serious cases of infestation, both the leaves and fruits are affected The attacked leaves (Plate XXXIV, Fig 2) can easily be spotted out by the presence of pale white spots on their upper surface

Cambodia cotton is yet another host plant of the mite Uppam (*Gossypium herbaceum*) and Karunganni (*G indicum*) have not been noticed to be infested by the above mite but they are subject to the attacks of a mite belonging to another family—Eriophyidae, details of which will be mentioned later

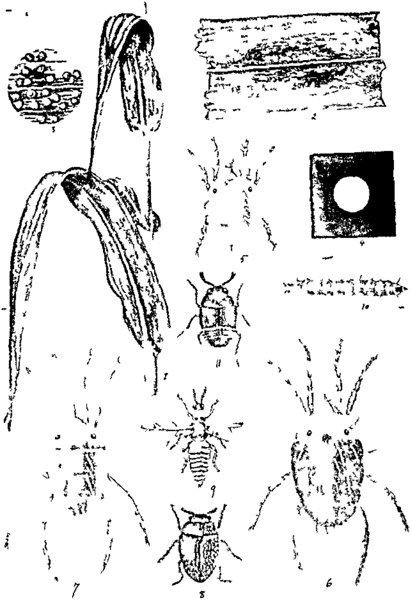
Rose and jasmine plants are also found to suffer at the hands of *Tetranychus telarius* In cases of severe infestation all the leaves dry up and wither, thus affecting the production of flowers

Tetranychus fici Hirst (Family—Tetranychidae) —These mites [Hirst, 1926], [Cherian, 1931] have been collected from figs (*Ficus carica*) and are known to feed on the leaves and fruits In South India these have been reported from Coimbatore and Hyderabad In the latter place the pest is stated to " cause damage of a severe type preventing ripening of the fruits " It has also been collected on the same host plant at Pusa

Tetranychus bioculatus Wood Mason (Family—Tetranychidae) —The pest [Fletcher, 1914], [Cherian, 1931] has been reported doing serious damage to the leaves of the tea plant in the Nilgiris It is generally found on the upper surface of the leaves and is mostly injurious during spells of dry weather. Dusting flowers of sulphur (one cwt per acre has given good results)

Tetranychus hindustanicus Hirst (Family—Tetranychidae) —This mite [Cherian, 1931] which is found on citrus varieties is greenish yellow in colour and produces small circular pale white patches on the leaves The same mite has been noticed in fairly large numbers on Persian *neem* (*Melia azadirachta*) and margosa (*Azadirachta indica*)

Tetranychus sp —A species of Tetranychus doing considerable damage to *Hibiscus esculentus* (Ladies' finger) has been collected from the Central Farm orchard, Coimbatore This appears to be a new species The mites are found in very large numbers on the under surface of leaves and the plants suffer badly due



Paratetranychus indicus Hirst

(Sorghum mite) and its natural enemies

1 Sorghum leaf showing mite attack
2 Mite attacked portion of leaf enlarged
3 Eggs of the mite
4 An egg enlarged
5 Nymh
6 Female
7 Male
8 *Scymnus gracilis Motsch*
9 *Scolothrips sexmaculata Pergande*
10 *Oligota flaviceps grub*
11 *O flaviceps Bernh*—adult

to their attack. Spraying of lime sulphur (one in forty) has given fairly satisfactory results. The mite has been reported to attack the same host plant in Cochin.

Paratetranychus indicus Hirst (Family—Tetranychidae).—The bright red colour which is found on the leaves of the *cholam* (Sorghum) plant is the outcome of attack of this mite [Hirst, 1923] ; [Cherian, 1933 ; 1934, 1] (Plate XXXV). A large number of eggs, larvae, nymphs and adults of this mite are found on the lower surface of affected leaves. The reddish colour of the leaves is the first visible symptom. The affected leaves dry up in a few days' time. The whole life cycle of the pest lasts from nine to twelve days, the egg, larval and nymphal periods being three to four, two to four and four days respectively.

The mites are found in most of the tracts where sorghum is grown. In the Central Farm, Coimbatore, the amount of loss has been roughly estimated at 5 per cent. The loss seems to depend on the age of the plants affected. If tender plants are attacked these may not produce any earheads at all while if the mites attack only during later period of the growth of the crop the earheads are not much affected.

Dusting of flowers of sulphur has given satisfactory results but it may not be economical to use this on a crop like *cholam*. The plants attacked first may be pulled out and destroyed so that the mites may not spread to other plants.

The same species has been noted on sugarcane for the first time in Coimbatore. The symptoms of damage are the same as on sorghum.

Paratetranychus punicae Hirst (Family—Tetranychidae).—The two host plants of the mite [Hirst, 1926] ; [Cherian, 1931] are pomegranate (*Punica granatum*) and grapevine (*Vitis vinifera*). These mites are greatly in evidence during certain seasons of the year, especially when tender leaves appear on the plants. If not checked in time, most of the leaves dry up and the yield of the plants get reduced considerably.

Various other species of Tetranychidae collected include *Paratetranychus oryzae* on paddy, *Raoiella indica* and *Tetranychus fijiensis* on coconut leaves and *Amenosius* sp. on coconut flowers. These are, however, found only occasionally.

Eriophyes carinatus Green (Family—Eriophyidae).—This mite [Fletcher, 1914] known popularly as " the purple mite of tea " is very small in size, measuring about one-fifth of a millimetre and with only two pairs of legs. It is found sometimes as a serious pest feeding on both sides of the leaf. The adult mite can be distinguished by the five ridges of waxy material found along the dorsum.

Eriophyes gossypiella (Family—Eriophyidae).—This is known as the Cottony Woolly Mite. It attacks Uppam (*Gossypium herbaceum*) and Karunganni (*G. indicum*) in Coimbatore and also in other parts of the Presidency where country cottons are grown. The affected leaves can be distinguished by the patches of

whitish hairs found on them The attack is generally noticed late in the season The mite has been reported as a pest of cotton in Bombay [Jhaveri, 1921]

NATURAL ENEMIES OF MITES

Of the various natural enemies of mites studied at Coimbatore, *Scymnus gracilis* (Family—Coccinellidae) (Plate XXXV, fig 8), *Scolothrips sexmaculatus* (Family—Thripidae) (Plate XXXV, fig 9) and *Oligota flaviceps* (Family—Staphylinidae) (Plate XXXV, figs 10 and 11) are the more important ones but these are not found in large numbers as to check the pest

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